SYNOPTIC WATER QUALITY SURVEY OF SELECTED HALIFAX REGIONAL MUNICIPALITY LAKES ON 28-29 MARCH 2000

by

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Synoptic Water Quality Survey Of Selected Halifax Regional Municipality Lakes On 28-29 March 2000

by

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ABSTRACT

On 28 and 29 March 2000, water samples were collected by helicopter and small boat from 51 Metro Area lakes, repeating the synoptic surveys of the same lakes conducted in 1980 and 1991. Samples were analyzed for the same suite of water quality variables (pH, major ions, nutrients, organic matter and elements). The most pronounced change observed over this 20 year period was the doubling of conductivity in most lakes. This was due to an increase in the concentration of major cations and anions, particularly sodium and chloride, derived from anthropogenic sources. There was no evidence of any long term change in pH, while Gran alkalinity increased. Nitrate concentrations appeared to increase while other nutrients appeared to remain relatively constant. There were no clear long-term trends in organic matter variables. Increases in variables were more pronounced in lakes with well-developed watersheds. Several lakes have high values for trophic status index and can be classified as eutrophic (Bissett and Russell). These data must be interpreted with caution as they represent just a single snapshot in time of highly dynamic natural systems. However, the results are in general agreement with those of other studies and contribute to the growing data base on Metro Area lakes.

RÉSUMÉ

Les 28 net 29 mars 2000, des échantillons d'eau ont été prélevés par hélicoptère et par petit bateau depuis 51 lacs de la région métropolitaine afin de répéter les levés synoptiques de ces mêmes lacs exécutés en 1980 et 1991. Ces échantillons ont été soumis à la même série d'analyses de variables de la qualité de l'eau (pH, principaux ions, éléments nutritifs, matière organique et éléments). Le changement le plus prononcé observé pour cet intervalle de 20 ans a été un doublement de la valeur de la conductivité dans la plupart des lacs. Il en est ainsi en raison d'une augmentation de la concentration des principaux cations et anions, et en particulier du sodium et du chlorure, provenant de sources anthropiques. Il n'y a aucune indication de changement à long terme du pH, alors que l'alcalinité telle que définie par la méthode de Gran s'est accrue. Les concentrations de nitrates semblent avoir augmenté alors que celles des autres éléments nutritifs semblent rester relativement constantes. Aucune tendance à long terme ne peut être dégagé en ce qui a trait aux variables associées à la matière organique. Les accroissements pour les variables ont été plus prononcés dans les lacs dont les bassins versants sont bien développés. Plusieurs lacs présentent des valeurs élevés en ce qui a trait à l'indice d'état trophique et peuvent être classés eutrophes (Bissett et Russell). Ces données doivent être interprétées avec prudence puisqu'elles ne représentent qu'un seul instantané d'un système naturel hautement dynamique. Cependant, ces résultats sont en général conformes à ceux obtenus dans le cadre d'autres études et s'ajoutent à la base de données en expansion sur les lacs de la région métropolitaine.

INTRODUCTION

The Halifax Regional Municipality (HRM), created in 1996 with the merger of Halifax, Dartmouth, Bedford and Halifax County, has a large number of lakes which are valuable resources for water supply, recreation and wildlife habitat. Urban development imposes various stresses on lakes and their watersheds, and careful environment management is necessary to maintain an acceptable level of water quality, both in built-up areas and regions undergoing development. Proper lake management requires an adequate scientific understanding of the natural processes that control lake properties, the types of pollutants being added, and their origin, concentrations and effects on important lake processes.

Due to the existence of numerous university and government environmental research laboratories, government environmental regulatory agencies and citizen environmental groups in HRM, a considerable number of scientific studies have been conducted on regional lakes (e.g., Gorham 1957, Ogden 1972, Gordon 1977, Gordon 1978, Watt et al. 1979, Castell et al. 1984, Soil and Water Conservation Society of Metro Halfax 1991, Scott et al. 1991, and Hellebrand and Dalziel 1992). As a result, a substantial data base is being accumulated. Major pollutants that have been identified in HRM lakes include silt, road salt, nutrients, acid precipitation and micro-organisms.

To help develop data bases for regional lake management, it was decided that it would be useful to conduct periodic synoptic water quality surveys of HRM lakes. Therefore, on 14 April 1980, a survey of 50 lakes was carried out on a single day (Gordon et al. 1981). The sampling took place immediately after ice out. At this time of the year, lake water is well-mixed from surface to bottom, and the properties measured in surface samples are representative, within certain limits, of the entire lake volume. Standard water quality variables (e.g. pH, conductivity, major ions and nutrients) were measured and the resultant data were used to rank HRM lakes with regard to water quality.

This survey was repeated in 1991 (Keizer et al. 1993). Two additional lakes were included. In addition, samples were analyzed for Secchi disk, aluminium, chlorophyll, colour, dissolved organic carbon and large number of trace elements.

The survey was repeated a third time in 2000. The same lakes were sampled as in 1991 and the same variables measured except Secchi disk. This report presents the 2000 results and compares them to the data obtained in 1980 and 1991. Several long-term trends are now becoming evident. The data from all three surveys are presented in the appendices for those who wish to carry the analysis and interpretation further.

METHODS

Sampling

Sampling began on 28 March, 2000 but had to be suspended due to rain. It was completed the following day. Sampling was conducted in a total of 86 locations in 51 lakes (Figure 1, Table 1). As in 1980 and 1991, samples were collected the day after the ice left Fraser Lake. In addition, for quality assurance purposes, replicate samples were collected from Lake Major, Lake Banook, Maynards Lake and Morris Lake. Most lakes were sampled by helicopter between 1200 h and 1600 h on 28 March and the remaining were sampled between 1000 h and 1230 h on 29 March. Samples were collected by helicopter with a weighted 2-L bottle holder and cleaned bottle lowered from the hovering aircraft to a depth of approximately 30-50 cm below the surface. Sample bottles were pre-cleaned with Decon® laboratory detergent and rinsed three times with 18.2 Mmoh deionized water. The sample bottles were retrieved and capped for laboratory processing. Smaller lakes in built-up areas were sampled by canoe on 28 April using pre-cleaned bottles fastened to a rod to ensure appropriate immersion. In small lakes, single samples were taken near their centre, while in larger lakes multiple samples were collected along the major axis (Figure 1). Each sampling team used pre-labelled bottles, a mercury thermometer, a sampling device and log sheets on which date, time, station number, BIO identification number, location and temperature were recorded. Samples were returned to the laboratory and processed within 4 h of collection.

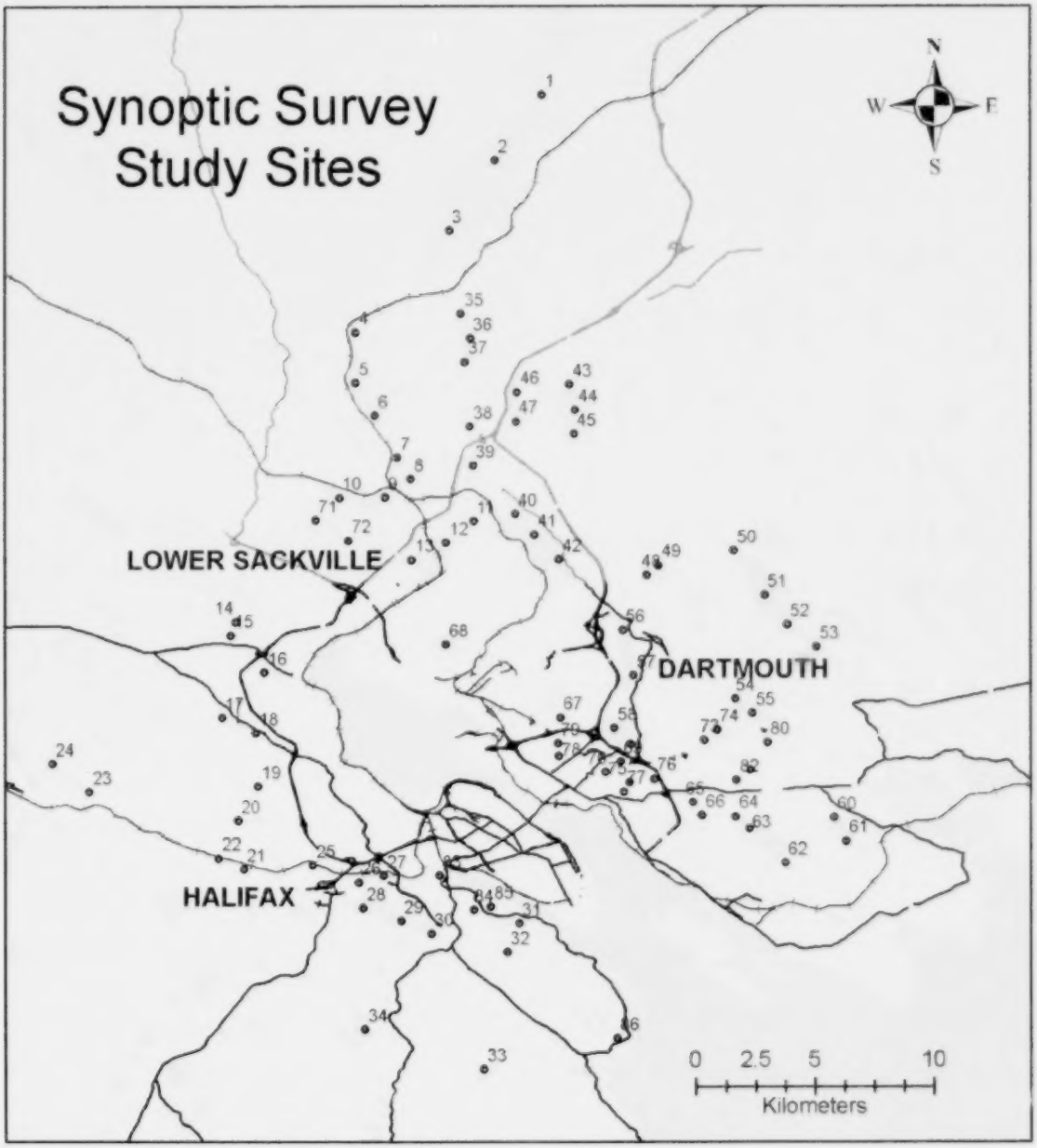

Figure 1. Location of sampling locations in the lakes that were sampled. See Table 1 for the key for the sample numbers.

Table 1. Sample numbers and lakes sampled. Multiple numbers for a given lake indicates that multiple samples were collected at different locations along the major axis. Replicate samples were collected at one station in the four lakes indicated. The location of lakes is shown in Fig. 1.

Sample no.	*Lake*	*Sample no.*	*Lake*
1-3	Grand Lake	48-49	Spider Lake
4-6	Kinsac Lake	50-53	Lake Major (Replicate)
7-8	Third Lake	54-55	Loon Lake
9-10	Second Lake	56-57	Lake Charles
11	Powder Mill Lake	58-59	Lake Micmac
12-13	Rocky Lake	60-61	Bissett Lake
14-15	Sandy Lake	62-64	Morris Lake (Replicate)
16	Paper Mill Lake	65-66	Russell Lake
17-18	Kearny Lake	67	Frenchman Lake
19-20	Susie Lake	68	Anderson Lake
21-22	Governor Lake	69-70	Lake Banook (Replicate)
23-24	Fraser Lake	71-72	First Lake
25	Bayers Lake	73	Lamont Lake
26	Second Chain Lake	74	Topsail Lake
27	First Chain Lake	75	Oathill Lake
28-30	Long Lake	76	Penhorn Lake
31	Williams Lake	77	Maynards Lake (Replicate)
32	Colbart Lake	78	Little Albro Lake
33	Parr Lake	79	Big Albro Lake
34	Spruce Hill Lake	80	Cranberry Lake
35-37	Lake Fletcher	81	Settle Lake
38-39	Lake Thomas	82	Bell Lake
40-42	Lake William	83	Chocolate Lake
43-45	Soldier Lake	84	Whimsical Lake
46-47	Miller Lake	85	Frog Pond
		86	Power Pond

Chemical Analysis

The 2-L sample bottles were returned to the Bedford Institute of Oceanography (BIO), kept refrigerated, and shaken in advance of sub-sampling for the various analyses. All sub-samples were labelled with the same numbered BIO labels as the source samples. The variables measured, the responsible laboratory and the units used in this report are listed in Table 2. Analyses were conducted at BIO, the Environment Canada (EC) laboratory in Moncton, and the Geological Survey of Canada (GSC) laboratory in Ottawa.

Table 2. The variables that were measured, the laboratory responsible for the analysis, and the units used in this report. Analyses were conducted at the Bedford Institute of Ocean (BIO) in Dartmouth, NS, the Environment Canada (EC) laboratory in Moncton, NB, and the Geological Survey of Canada (GSC) laboratory in Ottawa, ON.

Varaible	*Laboratory*	*Units*
Temperature	BIO	°C
pH	BIO and EC	pH units
Conductivity	BIO and EC	µS
Sodium (Na)	EC	mg/L
Calcium (Ca)	EC	mg/L
Magnesium (Mg)	EC	mg/L
Potassium (K)	EC	mg/L
Aluminum (Al)	EC	mg/L
Chloride	EC	mg/L
Sulphate (SO_4)	EC	mg SO_4 /L
Gran alkalinity	EC	mg $CaCO_3$/L
Ammonia (NH_3)	BIO	mg N/L
Nitrate (NO_3)	BIO and EC	mg N/L
Phosphate (PO_4)	BIO	mg P/L
Silicate (SiO_2)	BIO	mg Si/L
Total Nitrogen (TN)	EC	mg N/L
Total Phosphorus (TP)	EC	mg P/L
Chlorophyll	BIO	mg /L
Dissolved Organic Carbon (DOC)	EC	mg C/L
Colour	EC	TCU
Elements	GSC	µg/L

Bedford Institute of Oceanography (BIO)

Conductivity

80 ml of sample were transferred to a 100-ml breaker that had been rinsed with Milli-Q® water. The conductivity meter probe, rinsed with Milli-Q® water and blot dried with a Kimwipe®, was placed in the beaker with a stir bar. Conductivity was recorded when the meter and temperature had stabilized. Units are micro-Siemens (µS).

pH

Using the same sample, a rinsed but not dried probe was immersed for 30 sec before pH was recorded. pH at BIO was done on fresh(<4Hrs) samples while the EC analyses were conducted a few days later.

Nutrients

Nutrients measured at BIO were nitrate (NO_3) plus nitrite (NO_2), phosphate (PO_4), and silicate (SiO_2). After one rinse, sub-samples were filled to the bottom of the neck of 30-ml HDPE vials that had been previously washed, rinsed and dried. These were frozen at -18°C until analysis using Technicon AAII techniques described in Strain and Clement (1996) but modified for freshwater by using freshwater standards and wash-water. Limit of detection was 0.014 mgN/L for nitrate plus nitrite, 0.001 mg P/L for phosphate, and 0.006 mg Si/L for silicate. Nitrate was also analyzed by the EC laboratory using fundamentally the same method, the difference being that at BIO research level precision techniques were used resulting in a lower detection limit, ~0.014 versus ~0.5 mg/L at the EC laboratory.

Chlorophyll

Two 150-ml sub-samples were filtered through 0.5 µ GFF filters using suction filtration (<15 lb). Filters were then placed in HDPE scintillation vials with 10 ml of 90% acetone and stored in a darkened freezer (-18°C). Analysis was performed using a calibrated Turner fluorometer (Garret and Carpenter 1966). Units are mg chlorophyll a/L.

Environment Canada (EC)

Samples were transferred to 1-L sub-sample bottles that had previously been washed, rinsed and dried. A small rinse of sample water was shaken in the capped bottles and discarded before the bottles were filled to capacity. These 1-L samples were kept refrigerated before and during shipping to Moncton for analysis. All methods referenced in the following table are described in detail in the Environment Canada Analytical Methods Manual (1979).

Table 3 Methods and detection limits for analyses conducted by EC. Methods refer to the American Public Health Association, Standard Methods for water and wastewater, 20th Edition (1998) except for Total Nitrogen and Phosphorus which are from the Environment Canada Analytical Methods Manual (1979).

Variable	*Method*	*Detection Limit*
pH	Method 4500-H+B	
Specific Conductivity	Method 2510 B	
Sodium	Method 3500 Na b	5.0 µg/L
Calcium	Flame atomic absorption spectrometry	0.003 mg/L
Magnesium	Flame atomic absorption spectrometry	0.0005 mg/L
Potassium	Method 3500 K B	0.1 mg/L
Aluminum	Flame atomic absorption spectrometry	0.1 mg/L
Chloride	Method 4110B	4.0 µg/L
Sulphate	Method 4110 B	18 µg/L
Gran Alkalinity	Method 10110	
Ammonia	Method 4500-NH3 G	0.02 mg N/L
Nitrate	Method 4500 F	0.5 mg N/L
Total Nitrogen	Automated ultra-violet digestion	0.004 mg N/L
Total Phosphorus	Colourmetric sulphuric acid digestion	0.001 mg P/L
Total Organic Carbon	Method 5310	1.0 mgC/L
Colour	Method 2120A, 2011 Appearance	

In order to be consistent with previous reports the TOC measured is reported as DOC since there are only small quantities of particulate organic carbon present in these samples.

Geological Survey of Canada (GSC)

Elements

40 ml of sample was filtered through previously-washed Durapore Sterivex 0.45 µ Durapore Sterivex filters and discarded. Then, under light hand-pumped vacuum, water was filtered into 125-ml HDPE bottles which had been previously washed with 1% Supragrade nitric acid. This processing at BIO was done inside clear plastic bags to avoid airborne contamination. Sub-sample bottles were then shipped to Ottawa.

A 50 ml aliquot was filtered and analyzed for rare earth elements, first-row transition elements, lead, cadmium, and uranium by the Applied Geochemistry Laboratory of the Geological Survey of Canada. The sample was loaded onto a Dionex METPAC CC-1 column, eluted in 5 ml of 1N nitric acid, and analyzed by nebulisation ICP-MS. The column contained macroporous iminodiacetate chelating resin similar to Chelex-100. Therefore, this method determines the fraction of dissolved element chelated by this resin. Units are µg/L.

Data Quality and Analysis

Many of the variables measured are highly variable in both space and time in response to physical, chemical and biological factors. For some variables, natural concentrations are near the analytical limits of detection resulting in a large variance in replicate samples. The data for replicate samples are shown in Table 3. The variables with greatest variance were Gran alkalinity, silicate, total phosphorus, and phosphate. The high variance for both total phosphorus and phosphate is expected because of their low concentrations, complex chemistry in natural waters, and active role in biological processes.

There was good agreement between multiple samples taken from different locations in the same lake. Therefore, when two or more samples were collected from a lake, an average concentration was calculated for each variable in each lake.

Table 4. Results of three replicate samples collected at the same location (average concentration and percent standard deviation). Instances where the percent standard deviation exceeded 5% are shown in bold. Units are given in Table 2.

Lake	*Banook*		*Major*		*Maynard*		*Morris*	
Variable	*Average*	*%SD*	*Average*	*%SD*	*Average*	*%SD*	*Average*	*%SD*
pH	6.97	1.8	4.78	2.1	7.10	0.8	6.41	3.5
Conductivity	402	0.4	40.2	3.7	389.7	0.1	312	4.1
Sodium	59.2	0.4	3.6	0.8	58.4	1.0	45.1	4.8
Calcium	13.63	1.1	0.98	1.6	10.93	1.1	9.55	3.6
Magnesium	1.74	0.9	0.47	1.2	1.87	1.1	1.42	2.4
Potassium	1.1	1.5	0.2	2.3	1.2	3.3	1.0	2.5
Aluminum	0.025	**6.6**	0.207	1.5	0.019	**5.6**	0.039	**6.7**
Chloride	92.6	2.0	5.4	0.9	94.1	0.1	74.1	**5.6**
Sulphate	18.0	0.9	4.46	0.2	13.5	0.4	13.1	2.6
Gran alkalinity	16.0	**6.9**	-1.2	**7.6**	14.1	**5.0**	9.6	**7.9**
Ammonia	0.007	**5.9**	0.014	**6.0**	0.028	1.3	0.009	**15.7**
Nitrate	0.31	0.5	0.05	2.4	0.21	2.0	0.22	1.6
Phosphate	0.005	**45.6**	0.001	**106.8**	0.003	**31.5**	0.004	**41.1**
Silicate	0.56	**24.6**	0.02	**32.2**	0.32	**22.8**	0.12	**9.0**
Total N	0.31	**8.0**	0.10	0.0	0.24	2.4	0.23	**7.3**
Total P	0.009	**43.3**	0.005	**43.3**	0.012	**36.3**	0.015	**20.2**
Chlorophyll	2.01	4.4	0.45	**19.4**	0.74	1.0	3.60	**23.8**
DOC	3.6	**29.4**	4.2	**10.9**	4.4	2.3	3.3	**20.6**
Colour	5	0	15	**6.7**	5.3	**10.8**	6	**13.6**

Trophic status index (TSI) was calculated by the method of Carlson (1977) using chlorophyll values.

Data for each variable are plotted on a horizontal bar graph with concentration across the x-axis (horizontal) and lakes in ascending order according to 2000 concentration along the y-axis (vertical). Data collected in 1980 and 1991 are plotted on the same axes for comparison. All data for 2000 and the average values for each lake for the 1980 and 1991 surveys are presented in the Appendices. Complete datasets for 1980 and 1991 can be found in the reports for those surveys. Statistical analyses were performed using the add-on statistical functions for Microsoft Excel 2002.

RESULTS

Before the data are presented, it must be emphasized that they should be interpreted with caution. The water quality variables measured can display strong spatial and temporal variability. The effects of spatial variability have been reduced in this study by collecting samples at the time of the spring turnover, when lakes are vertically well-mixed, and by collecting multiple samples in large lakes, but they have not been completely eliminated. Temporal variability occurs over the scales of hours, days and months. Major wind and precipitation events have a pronounced effect on lake water quality. These effects have been reduced by collecting all samples on the same day, but again they have not been completely eliminated, especially since about 30 hr elapsed between the collection of the first and last samples. In addition, as is shown in the replicate sample data (Table 4), some variables are more difficult to measure precisely than others. For these reasons, one must be careful in comparing average concentrations of individual lakes, either against other lakes or against the 1980 and 1991 data, for they are based on limited number of samples and some of the apparent differences may not be statistically significant. Many of these data do not meet the requirements for rigorous statistical analyses.

It must be kept in mind that the purpose of this project is to provide a synoptic overview of the water quality of HRM lakes on a given date and to seek general trends of change over decadal time scales. Any indications of serious environmental concerns coming out of this project will require further investigation using a more detailed sampling regime that would provide the precision necessary to answer the specific questions being asked.

Temperature

Water temperature ranged from 3.2 to 9.9 C (Fig. 2). As in previous surveys, the higher temperatures were generally found in the shallower, smaller lakes that lost their ice cover earlier. Temperature was generally slightly lower then when the lakes were sampled in 1991 but slightly higher then when sampled in 1980. Water temperature is one of the physical factors that influence biological activity which in turn complicates the comparison of various biologically sensitive variables such as nutrients between years.

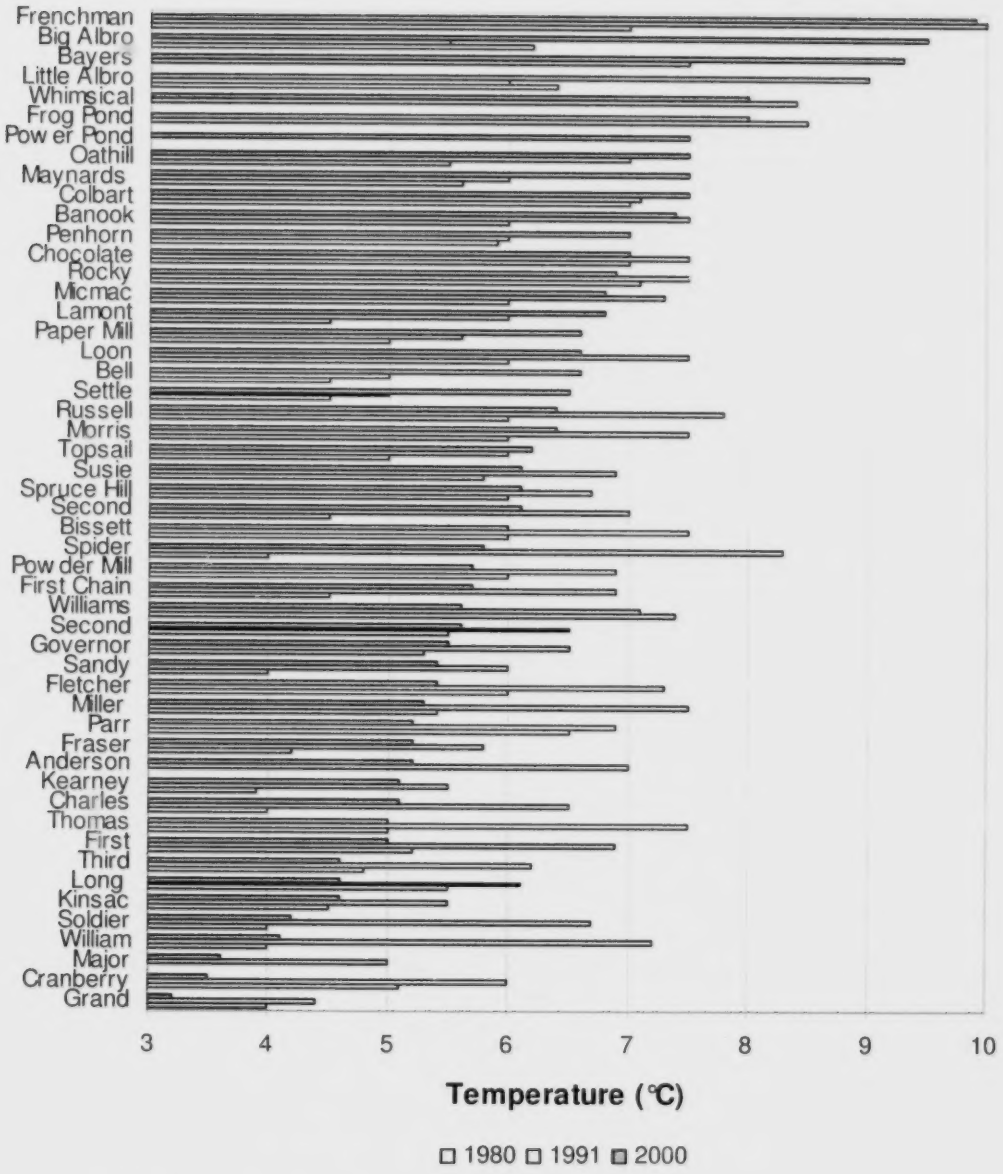

Figure 2. Average surface water temperature (°C).

Table 5. Means and standard deviations (SD) for all variables for the 3 years of the study and a comparison of data for each year for each variable using a paired t-test. The degrees of freedom was a minimum of 43 so the critical value of t for P<.05, i.e. that there is a difference, is approximately 1.7. If the absolute value of t is greater than 1.7 there is likely a significant difference in the concentrations for the two years being compared. (ND is no data.)

							Pair-wise Comparisons		
	1980		**1991**		**2000**		**80 vs 91**	**2000 vs 91**	**2000 vs 80**
Variable	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**t**	**t**	**t**
pH	6.03	0.91	5.93	0.85	6.27	0.64	**1.90**	**4.40**	**3.00**
Conductivity	156.3	130.6	267.3	215.3	271.1	181.6	**-6.50**	0.40	**7.80**
Sodium	20.6	18.6	37.8	32.3	39.5	28.3	**-6.30**	1.40	**7.90**
Calcium	6.15	5.7	7.26	5.3	8.25	5.3	**-4.10**	**4.40**	**6.00**
Magnesium	1.14	0.62	1.25	0.69	1.29	0.56	**-2.30**	0.80	**3.10**
Potassium	0.94	0.61	1.06	0.62	0.91	0.48	**-4.50**	**-3.80**	-0.40
Aluminium			0.38	0.75	0.14	0.17		**2.80**	
Chloride	34.9	32.5	61.21	53.1	64.9	46.6	**-4.30**	1.60	**5.30**
Sulphate	13.94	8.4	15.3	11.7	12.21	5.48	-1.40	**-2.90**	**-2.90**
Alkalinity	4.58	5.61	5.25	6.17	7.01	8.36	**-2.00**	**4.40**	**4.30**
Ammonia	0.037	0.048	0.012	0.015	0.019	0.019	**3.90**	**2.90**	**-2.60**
Nitrate	0.075	0.079	0.15	0.13	0.19	0.15	**-5.20**	**2.50**	**6.60**
Phosphate	0.0035	0.0006	0.0029	0.0016	0.0029	0.0017	0.70	0.00	-0.70
Silicate	0.274	0.33	0.106	0.1	0.173	0.191	**3.40**	**2.70**	**-1.80**
Total Nitrogen	0.284	0.179	0.318	0.168	0.226	0.157	**-2.30**	**-4.40**	**-2.50**
Total Phosphorus	0.007	0.008	0.012	0.006	0.01	0.005	**-2.80**	-1.10	**2.50**
Chlorophyll a	ND		2.66	3.47	2	2.08		**1.70**	
DOC	ND		2.69	1.03	4	1.42		**-8.50**	
Colour	ND		18.08	11.24	13.09	10.69		**6.00**	
TSI	ND		35.4	8.9	33.4	9.1		**1.70**	

pH

pH is a measure of the hydrogen ion concentration in water. A pH reading of 7 represents neutral conditions, while lower values indicate acid conditions and higher ones indicate alkaline conditions. Because of their geological setting and abundance of acid-producing slate, Metro Area lakes are naturally acidic and few probably had pH values above 6 a century ago. pH is determined by the chemistry of all dissolved ions present but is controlled largely by the carbonate system.

In some instances there were considerable differences between the pH measured at BIO and the pH measured several days later by EC for the same sample. This is not surprising given the various physical, chemical and biological factors that impact the observed pH. For presentation and discussion the pH values determined at BIO, within 4 hours of sample collection, are used.

Values of pH ranged from a low of 4.8 in Spruce Hill Lake to a high of 7.3 in Penhorn Lake (Fig. 3). The lowest values are generally found in lakes with relatively undisturbed watersheds while the highest values are generally found in lakes with well-developed watersheds.

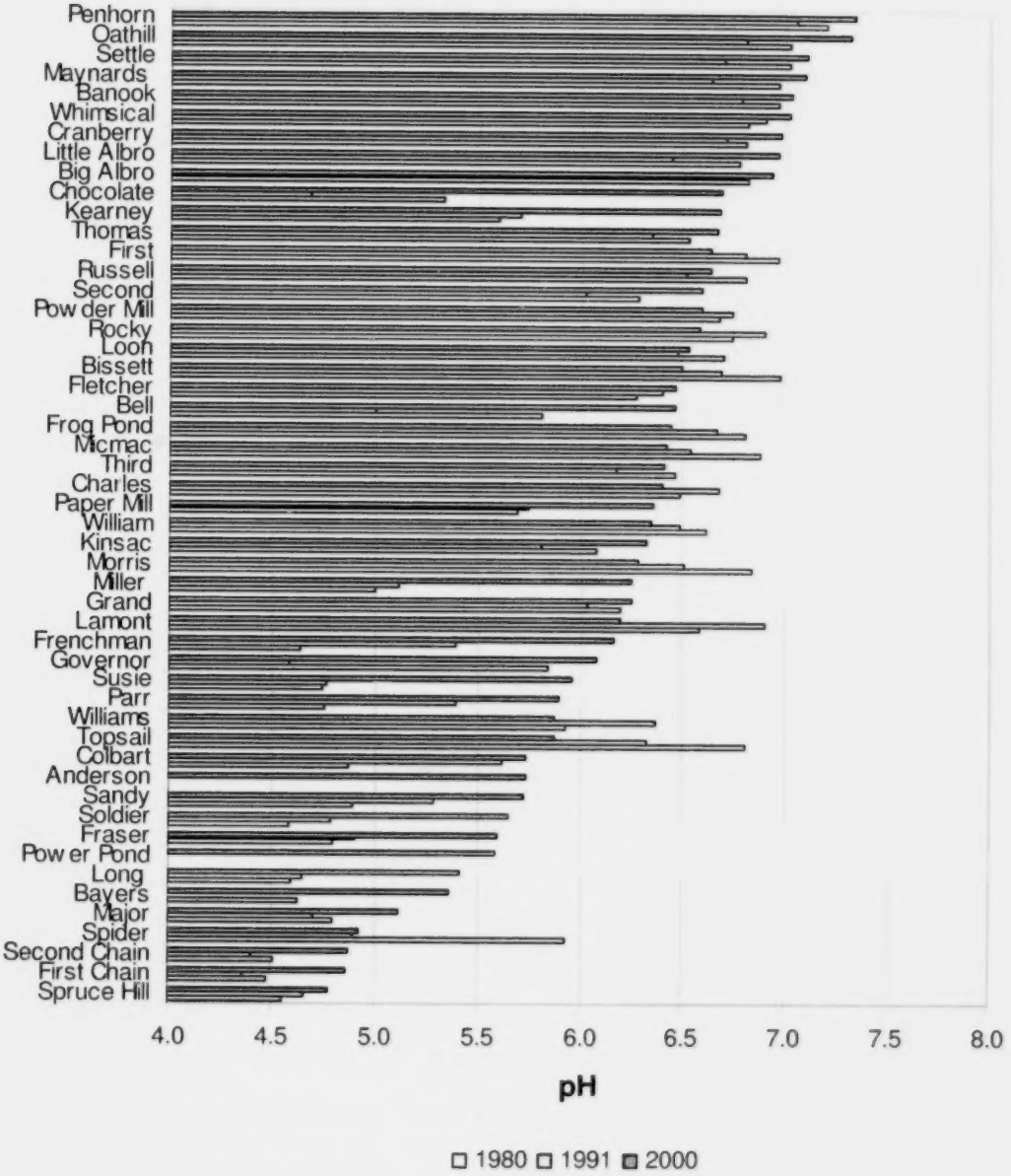

Figure 3. Average pH values for samples.

Human activity can both increase and decrease the pH of lakes. Decreases brought about by acid precipitation have been well documented in Halifax County lakes (Watt et al. 1979). Most of the Metro Area lakes with a pH of less than about 6 have probably been influenced by acid precipitation. Recent monitoring data suggest that international controls on sulphate emissions are having an effect and that some Nova Scotian lakes are beginning to show signs of recovery (Clair et al. 2003). Conditions are now considerably better than they were in 1975 at the worst of the acid deposition. Increases in pH are brought about by removing naturally occurring acidic habitats, such as acid bogs, and adding alkaline contaminants such as carbonate (the major component of lime which is extensively used on lawns and gardens).

The overall range of pH values was practically identical in all three surveys (Fig. 3). However, there was a hint of a possible increase in the mean pH of all lakes over the 20 year observation period (Table 4). It is notable that pH values fluctuated greatly in some lakes (e.g. Chocolate, Kearney, Miller, Spider), but it is not possible to determine the significance or cause of these fluctuations. pH in lake waters is unstable and can vary markedly over a 24 hour period due to natural biological and chemical processes and so the type of pH data collected in these surveys is of limited use as a comparative measure.

Conductivity

Conductivity is a measure of total dissolved ions in a water sample. All dissolved ions contribute but most of conductivity measured is due to the most abundant cations and anions. Conductivity is a relatively robust variable which is easily measured and not influenced much by highly variable biological processes. Therefore, a high degree of confidence can be placed upon this data set.

A wide range of conductivity readings is found in Metro Area lakes (Fig. 4)[3]. The lowest readings, on the order of 30 µS or less, reflect natural levels of conductivity which are caused by dissolved ions derived from the weathering of rock and precipitation of sea salt. Not surprisingly, these low levels are found in lakes with relatively undisturbed watersheds (Spider, Parr, Spruce Hill, Major, and Bell). The rest of the lakes have levels that have been increased by human activity, some to a considerable degree. As expected, lakes with the highest readings have well-developed watersheds (Whimsical, Bissett, Cranberry, Penhorn and Russell).

The elevated conductivity readings reflect increased concentrations of dissolved ions which are derived from the use of chemicals such as road salt, lime and fertilizers in watershed areas. These chemicals are water soluble and enter the lakes in storm water runoff. Air pollutants added to lakes by precipitation can also elevate conductivity readings.

Between 1980 and 1991, conductivity increased in every lake sampled, even in those lakes with the lowest readings (Fig. 4). On average, this increase was on the order of a factor of two (Table 4). Between 1991 and 2000, conductivity increased further in some lakes (Paper Mill, Kearny,

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[3] Theoretical conductivity is plotted in Figure 4 since there appears to be some inconsistencies in the measured conductivity in 1980.

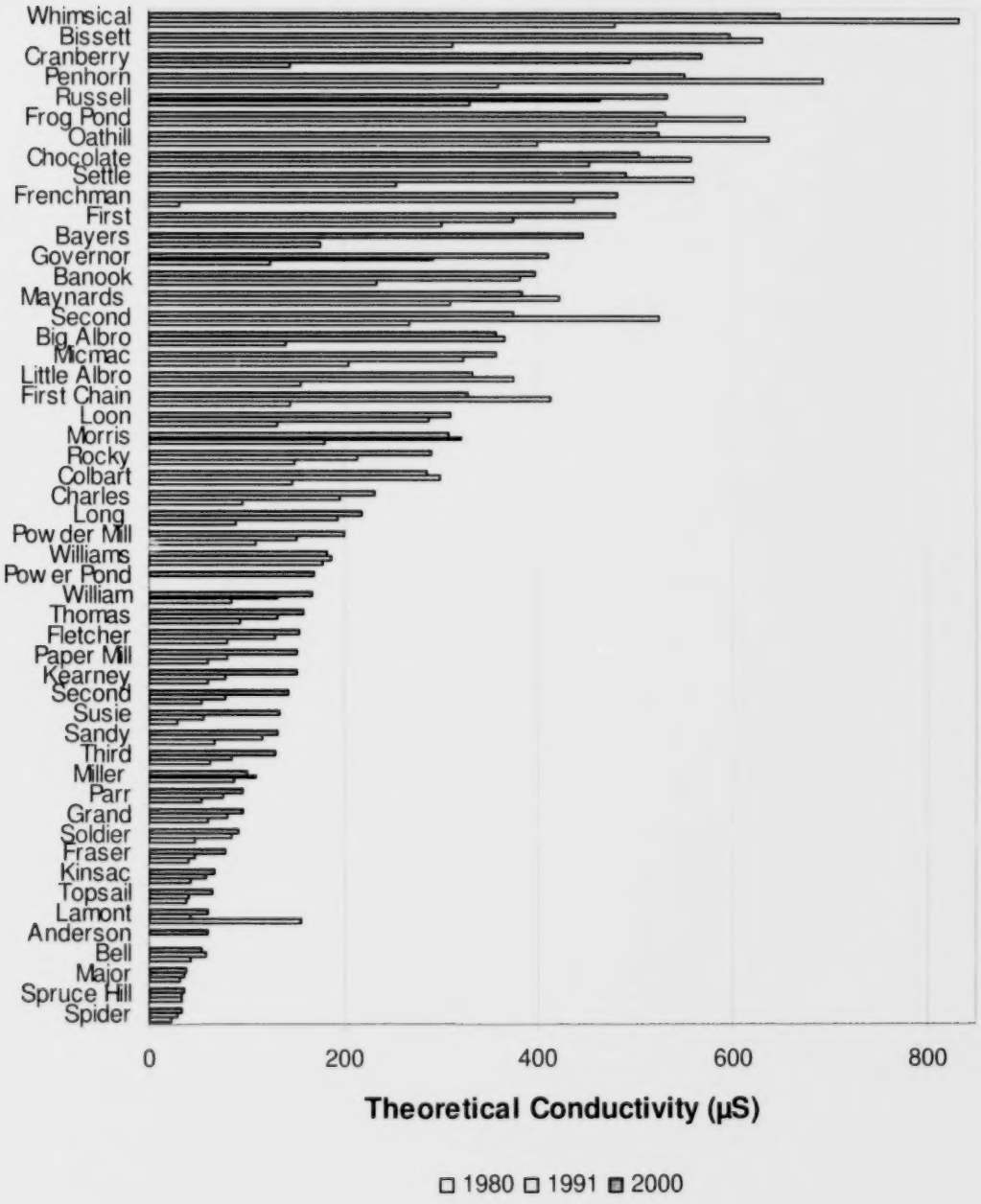

Figure 4. Average theoretical conductivity (µS) values.

Bayers and Russell) while in others it remained relatively constant or declined slightly. Overall, the mean value for all lakes increased just slightly over this 9 year period (Table 4).

Theoretical conductivity, calculated from the concentration of individual cations and anions measured by different analytical methods, is in excellent agreement with measured values (slope = 1.001, $r^2 = 0.999$). This correlation was stronger and the agreement was better than in previous years. This is a verification of the accuracy of the analyses for the major cations and anions.

Major Cations

Cations are those ions that carry a positive charge. Those measured in this study were sodium, calcium, magnesium, potassium and aluminum.

The concentrations of sodium, calcium, magnesium and potassium observed are plotted in Figs. 5-8. As with conductivity, the lowest values observed reflect natural levels derived from the weathering of rock and atmospheric input of sea salts. Those lakes with the lowest conductivity readings not surprisingly also have the lowest concentrations of sodium, calcium, magnesium and potassium. However, most of the lakes sampled appear to have concentrations above background levels. The most abundant cation is sodium (Fig. 5), followed by calcium (Fig 6). In comparison, concentrations of both magnesium and potassium are much lower but similar (Figs. 7 and 8). It is notable that the relative ranking of the lakes is very similar for each of these cations indicating that their ratios are quite constant. Lowest concentrations are consistently found in Major, Spruce Hill and Spider Lakes while highest in Whimsical, Bissett and Oathill Lakes.

In comparing 1991 with 1980, it is clear that there was a substantial increase in sodium concentrations in many lakes (Fig. 5). On average, this increase was almost by a factor of two (Table 4). There also was a slight increase of calcium in most of the lakes sampled (Fig.6). However, it was difficult to detect a trend in magnesium and potassium (Figs. 7 and 8). Between 1991 and 2000, the concentrations of sodium and calcium went up in some lakes but down in others (Figs. 5 and 6) with only slight increases in mean values (Table 4). Over the 20 year observation period, there was no apparent change in the mean concentration of both magnesium and potassium (Table 4).

The aluminum in lake water in the Metro Area is mostly derived from the weathering of rock and soil in the watershed. It behaves quite differently from the other cations measured. Aluminium was not measured in 1980. Concentrations are generally quite low (Fig. 9). In 2000, the higher values in some lakes observed in 1991 were not repeated. The range of concentrations in 2000 was 0.02 to 0.92 mg/L while in 1991 values as high as 3.63 were measured. The highest concentrations tended to occur in lakes with low pH which are found in relatively undeveloped watersheds such as Sandy and First Chain Lakes. Lowest concentrations were found in heavily developed watersheds such as Penhorn, Maynard and Albro Lakes. Concentrations were negatively correlated with pH ($r^2 = 0.66$). Similarly the aluminium concentrations for the two survey years were more strongly correlated if high values for 1991 and were omitted. The high

values observed may represent sample contamination.

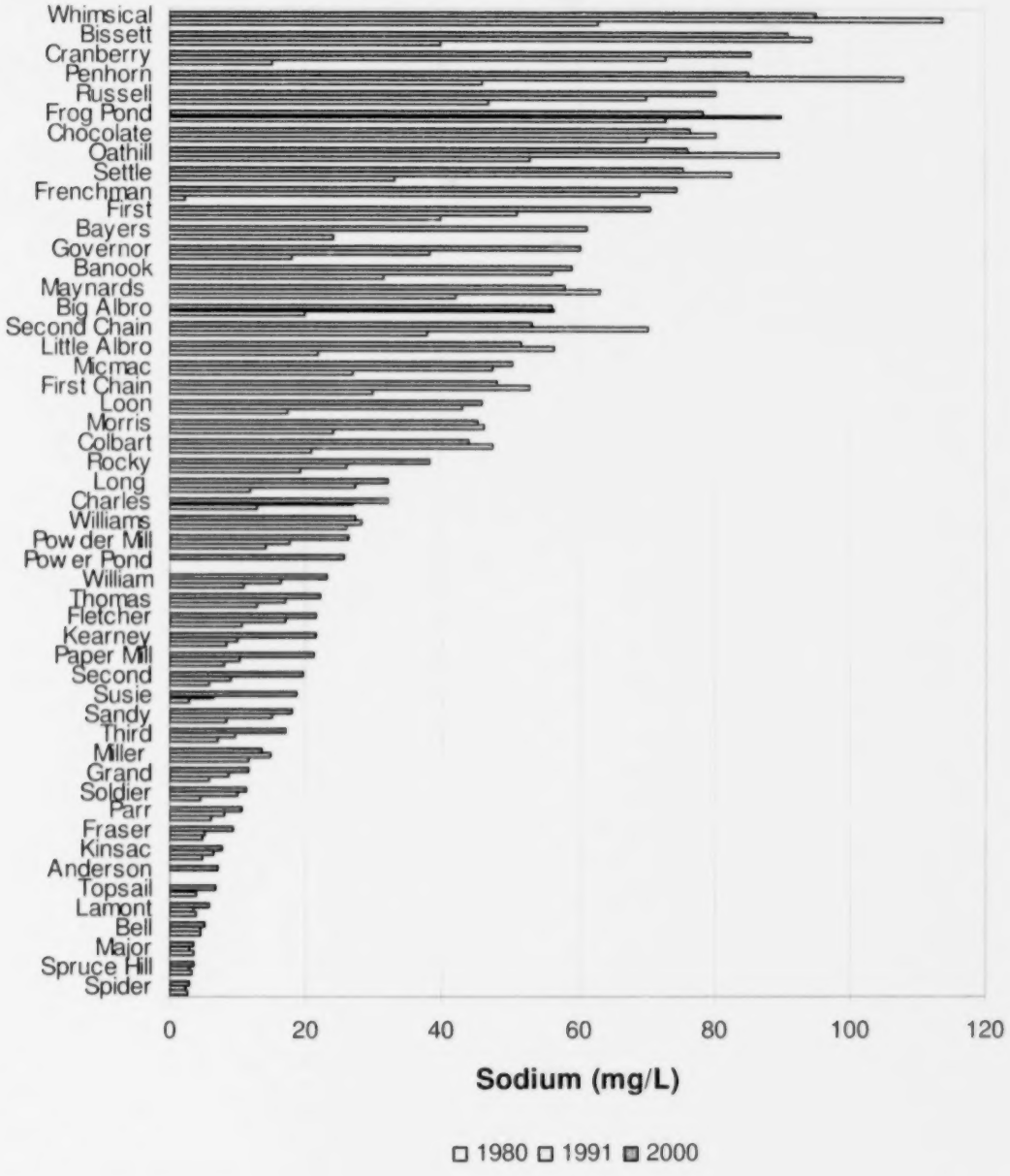

Figure 5. Average sodium concentrations (mg/L) for samples.

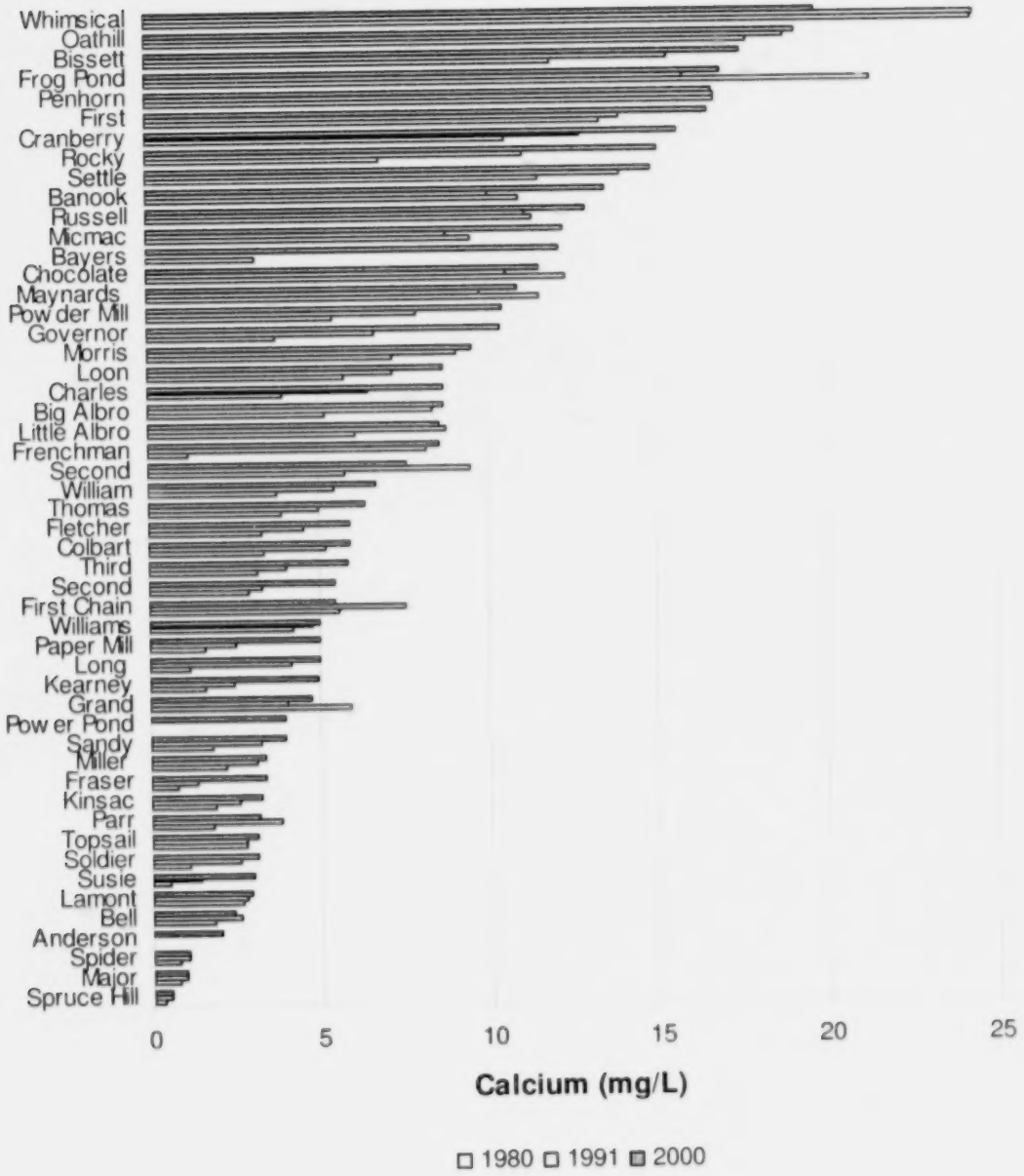

Figure 6. Average calcium concentrations (mg/L) for samples.

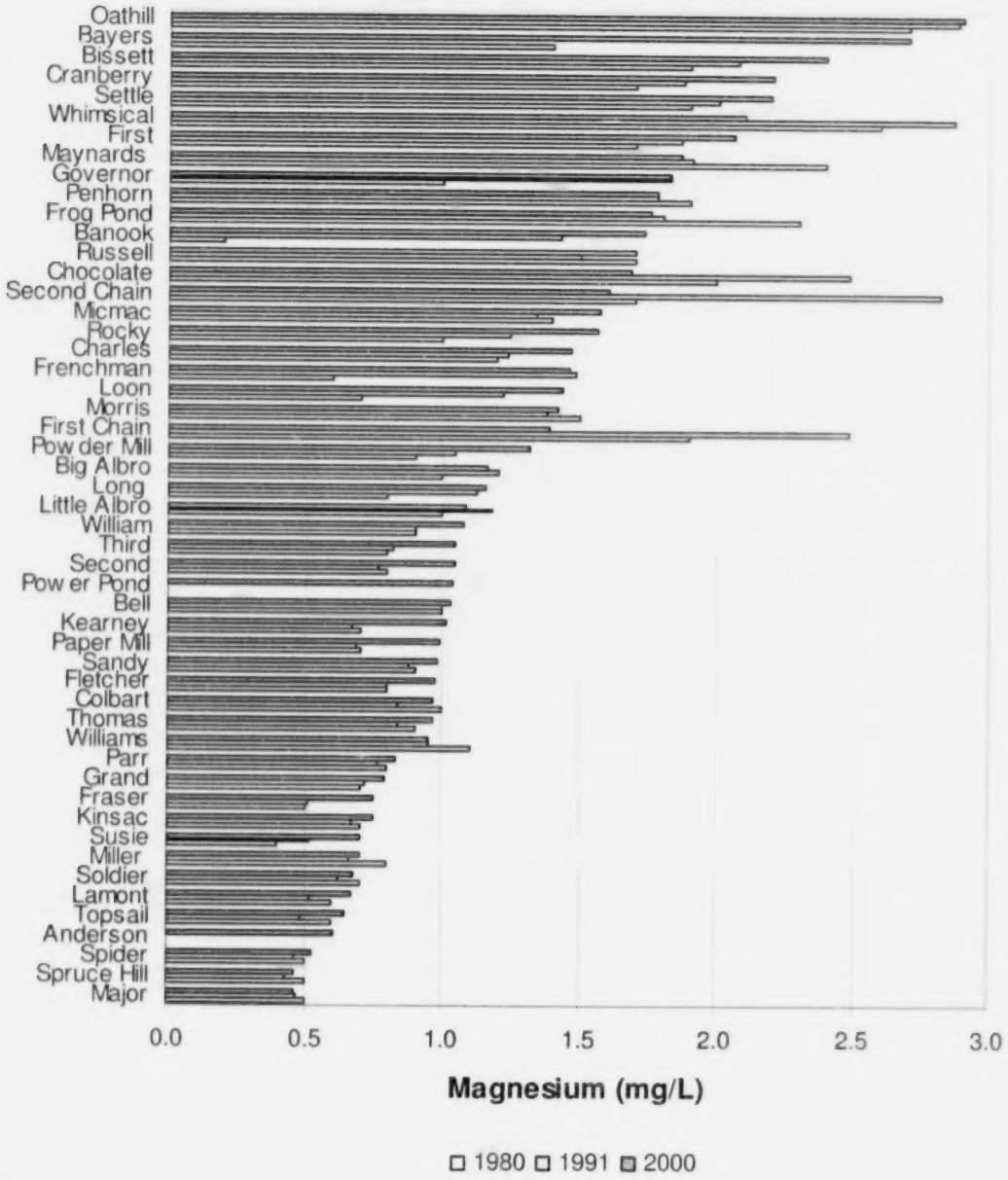

Figure 7. Average magnesium concentrations (mg/L) for samples.

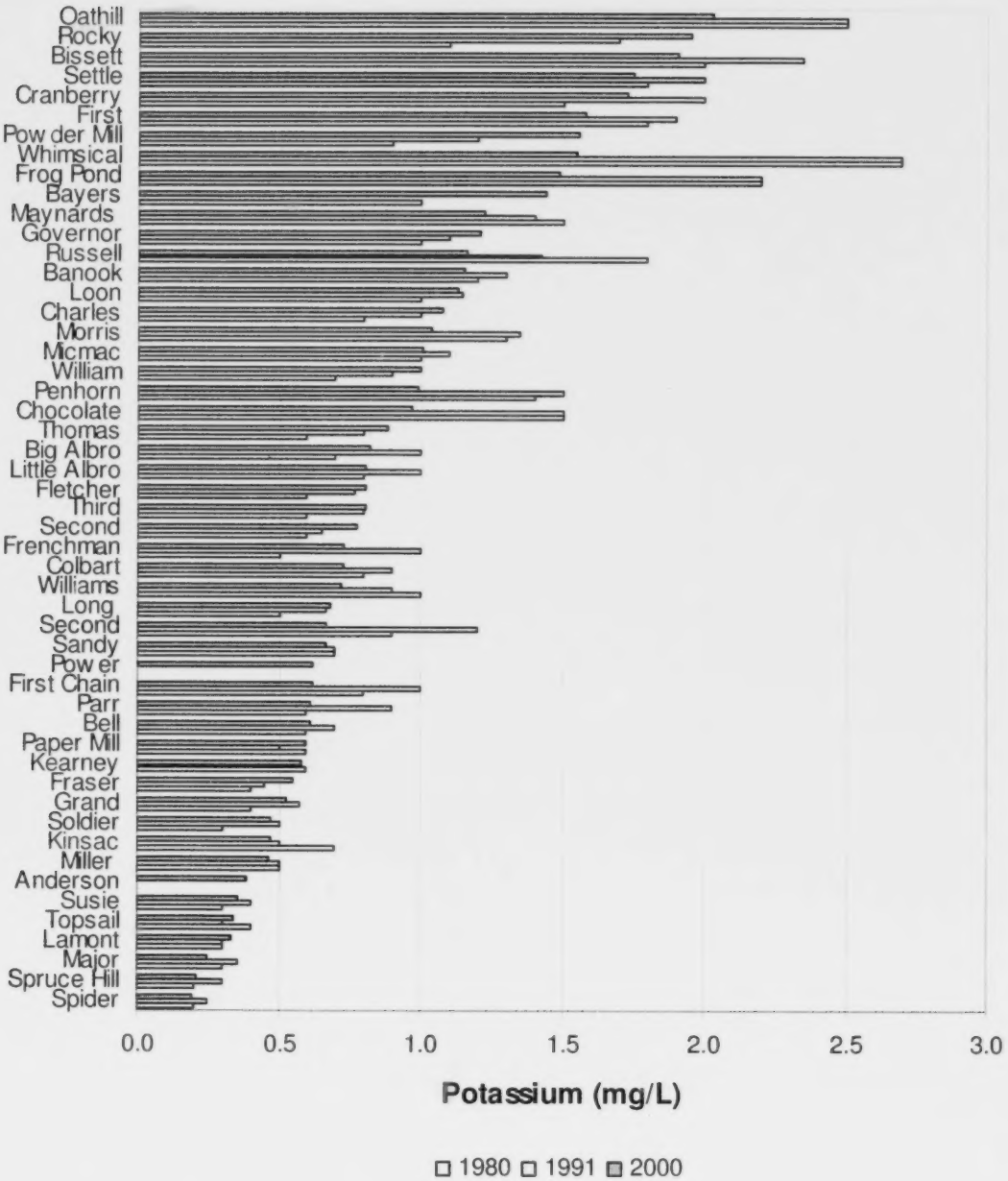

Figure 8. Average potassium concentrations (mg/L) for samples.

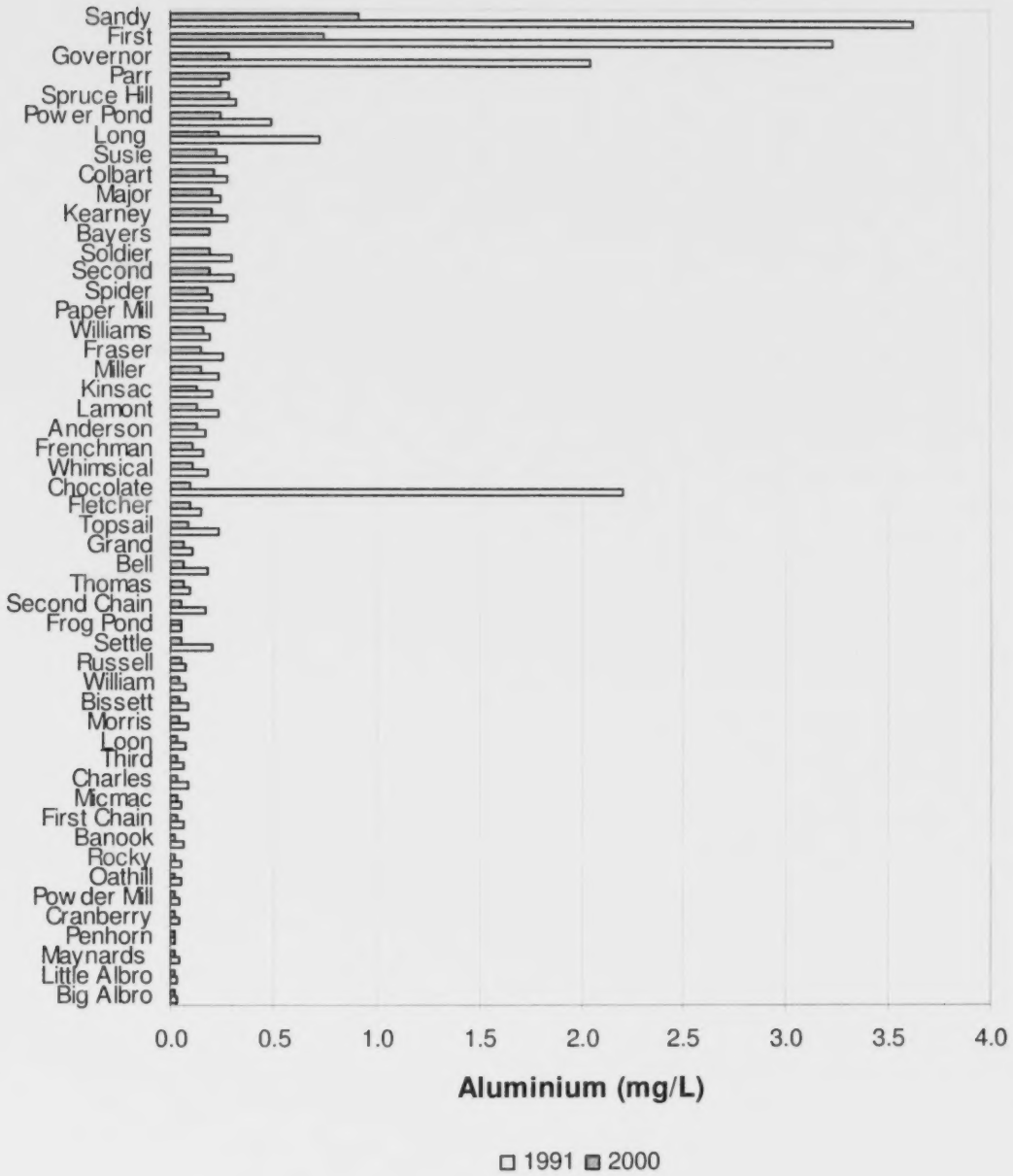

Figure 9. Average aluminium concentrations (mg/L) for samples.

Major Anions

Anions are those ions which carry a negative charge. The major anions measured in this study were chloride, sulphate and those that contribute to Gran alkalinity (e.g. carbonate bicarbonate, etc.). Under natural conditions, the concentrations of anions in Metro Area lakes are quite low and, like both conductivity and major cations, the major sources are the weathering of rock and the input of sea salt by precipitation.

A wide range of chloride, sulphate and Gran alkalinity concentrations are found in Metro Area lakes (Figs. 10-12). Those lakes with the lowest concentrations are also those lakes with the lowest values for conductivity and major cations. Most of the lakes sampled have concentrations that appear to exceed background levels. Chloride is by far the most abundant anion. As expected, there is a very close relationship between Gran alkalinity and pH. Lakes with high Gran alkalinity (i.e. well-buffered) have high pH while lakes with no Gran alkalinity (i.e. poorly-buffered) have low pH (Figs. 3 and 12).

Comparing 1980 and 1991, there was a very pronounced increase in the concentrations of chloride in most of the lakes, especially those in well-developed watersheds (Fig. 10). Like sodium, the mean values almost doubled (Table 4). There was a slight increase in chloride concentrations between 1991 and 2000.

Sulphate concentrations did not change significantly between 1980 and 1991 (Fig. 11 and Table 4) and the values in 2000 were lower than in 1981 and 1991.

Approximately one third of the lakes sampled have little or no Gran alkalinity (Fig. 12). These are primarily lakes with low pH in relatively undeveloped watersheds. Gran alkalinity increased in many of the lakes between 1980 and 1991, and further increases were observed in many lakes between 1991 and 2000 (Fig. 12). A gradual increase in Gran alkalinity was evident over the twenty year observation period (Table 4).

It should be noted that there are some technical problems regarding the reporting of sulphate concentrations and Gran alkalinity. Sulphate concentrations can be reported as mg of sulphate or as mg sulphur (mg sulphate will be 3 times the mg sulphur). Values in this report are mg sulphate. Similarly Gran alkalinity can be reported in a number of ways; however current practice is to use the units, mg $CaCO_3$/L. In the 1980 report (Gordon et al. 1981), the units, µequivalents/L were used. In the 1991 report (Keizer et al. 1993), the 1980 data were reported as mg $CaCO_3$/L but the conversion of the 1980 data was done incorrectly. The values for the 1980 data in that report need to be multiplied by 2.5 to make them correct. The values reported here for all three years are mg $CaCO_3$/L.

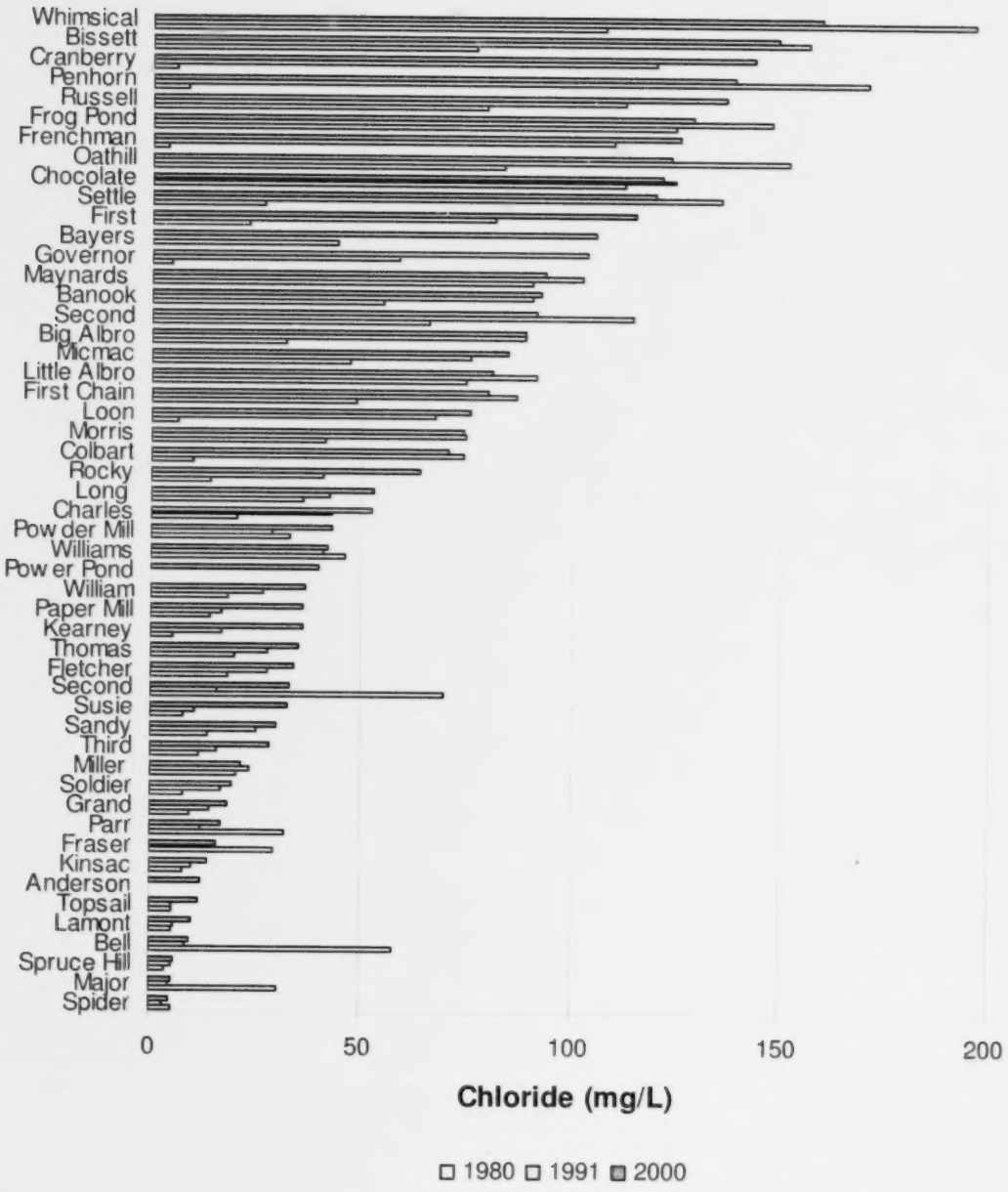

Figure 10. Average chloride concentrations (mg/L) for samples.

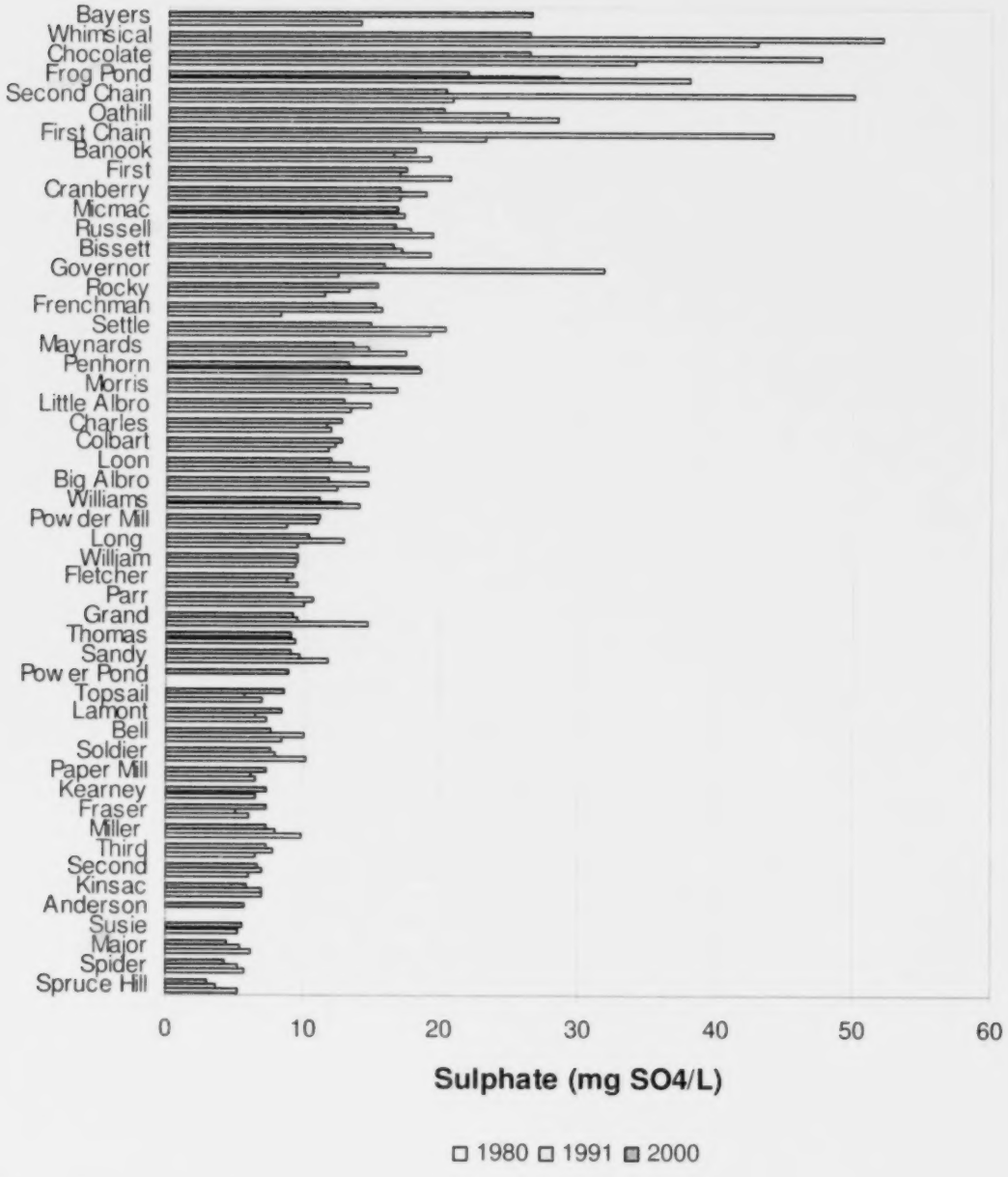

Figure 11. Average sulphate concentrations (mg SO_4/L) for samples.

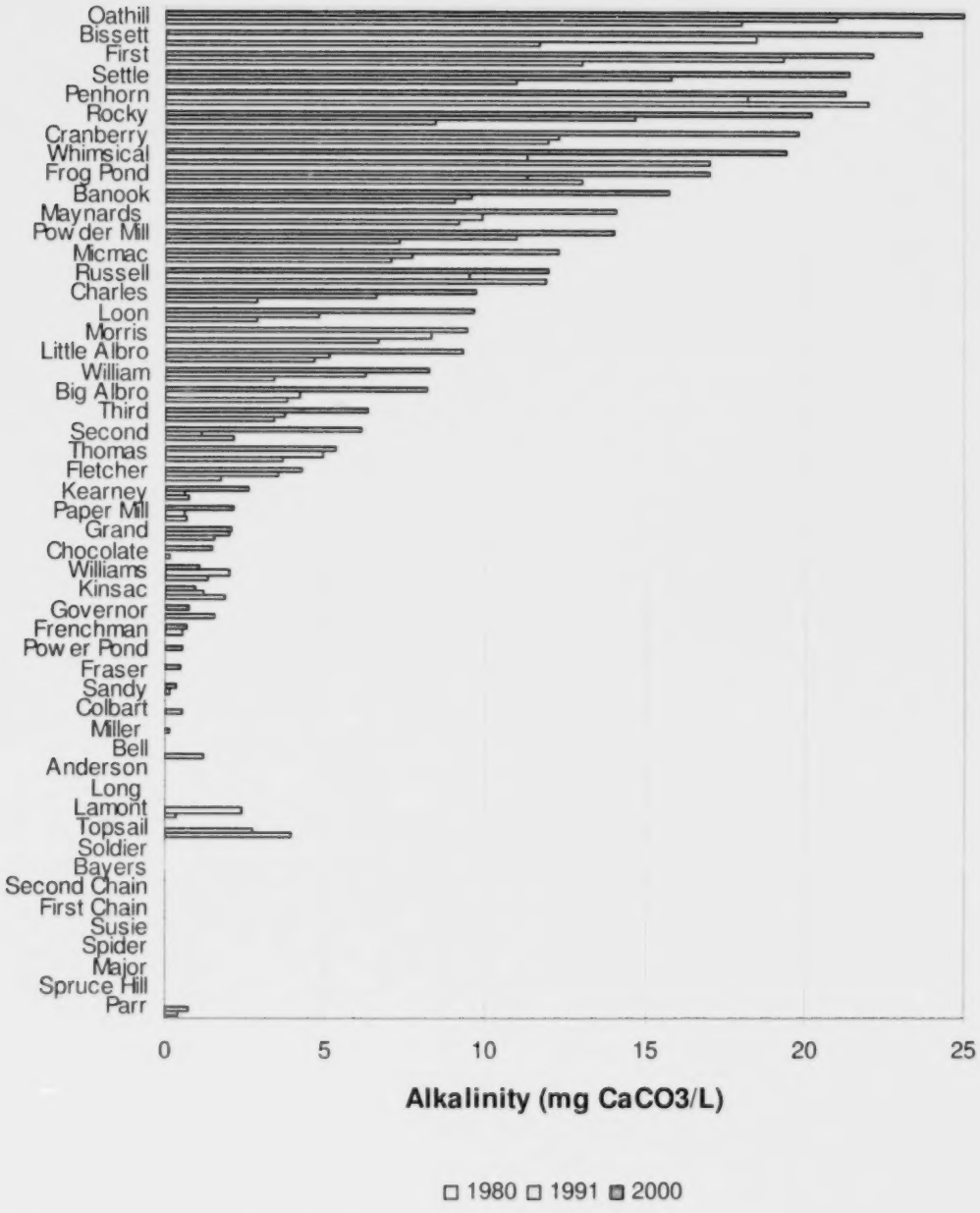

Figure 12. Average Gran alkalinity (mg $CaCO_3$/L) for samples.

Nutrients

Nutrients are compounds of elements such as nitrogen, phosphorous and silicon that are required for the growth of aquatic plants. Under natural conditions, their concentrations are very low (less than 1 mg L^{-1}) so that they contribute very little to conductivity readings. Natural sources include weathering of rock, decay of organic matter, and atmospheric input. There are numerous anthropogenic sources which include sewage and fertilizers. Four specific inorganic nutrients were measured in this study; ammonia, nitrate, phosphate and silicate. In addition, total nitrogen and phosphorus were measured which include both organic and inorganic forms.

Ammonia concentrations are very low (Fig. 13). There was no obvious correlation between concentrations and degree of lake watershed development as might be expected. The highest concentrations were found in Soldier and Miller Lakes which have watersheds with relatively low levels of development while urban lakes such as Cranberry and Banook had low concentrations. Nitrate concentrations were substantially higher (Fig. 14). Generally speaking, the highest values of nitrate were found in lakes with well-developed watersheds. Like ammonia, phosphate concentrations were very low and most were close to the limits of detection (Fig. 15). Again, the highest values were found in lakes with well-developed watersheds. Silicate concentrations were in the same range as nitrate (Fig. 16) and the highest values tended to occur in more developed watersheds. Total nitrogen and total phosphorous are plotted in Figs. 17 and 18.

Ammonia concentrations measured in 1991 were substantially lower than those in 1980 (Table 4). This decrease is probably not real but the result of improved handling procedures in 1991. Ammonia is a very labile compound which must be measured immediately before it undergoes chemical and/or biological transformations. In 1980, samples were stored for two days before analysis, while in 1991 they were analyzed immediately upon return to the laboratory. In 2000, ammonia was lower in some lakes and higher in others compared to 1991. Over the twenty year observation period, there was no clear trend in average concentration (Table 4). Nitrate concentrations measured in 1991, on the other hand, were substantially higher than those in 1980 (Fig. 14), even in the lower concentration range. In 2000, concentrations were higher in some lakes and lower in others. Overall, there was evidence of gradually increasing mean nitrate concentrations over the 20 year observation period (Table 4). However, there was no evidence of an increase in mean phosphate concentrations over the 20 year observation period (Table 4).

Silicate concentrations measured in 1991 were lower and much less variable than measured in 1980 (Fig. 16). It appears that there were analytical problems in 1980 which may have been caused by storage conditions. Silicate concentrations measured in 2000 were slightly higher on average than those measured in 1991. There was no evidence of a significant trend over the 20 year observation period (Table 4). There also appeared to be no detectable long-term trends in either total nitrogen or total phosphorous (Table 4).

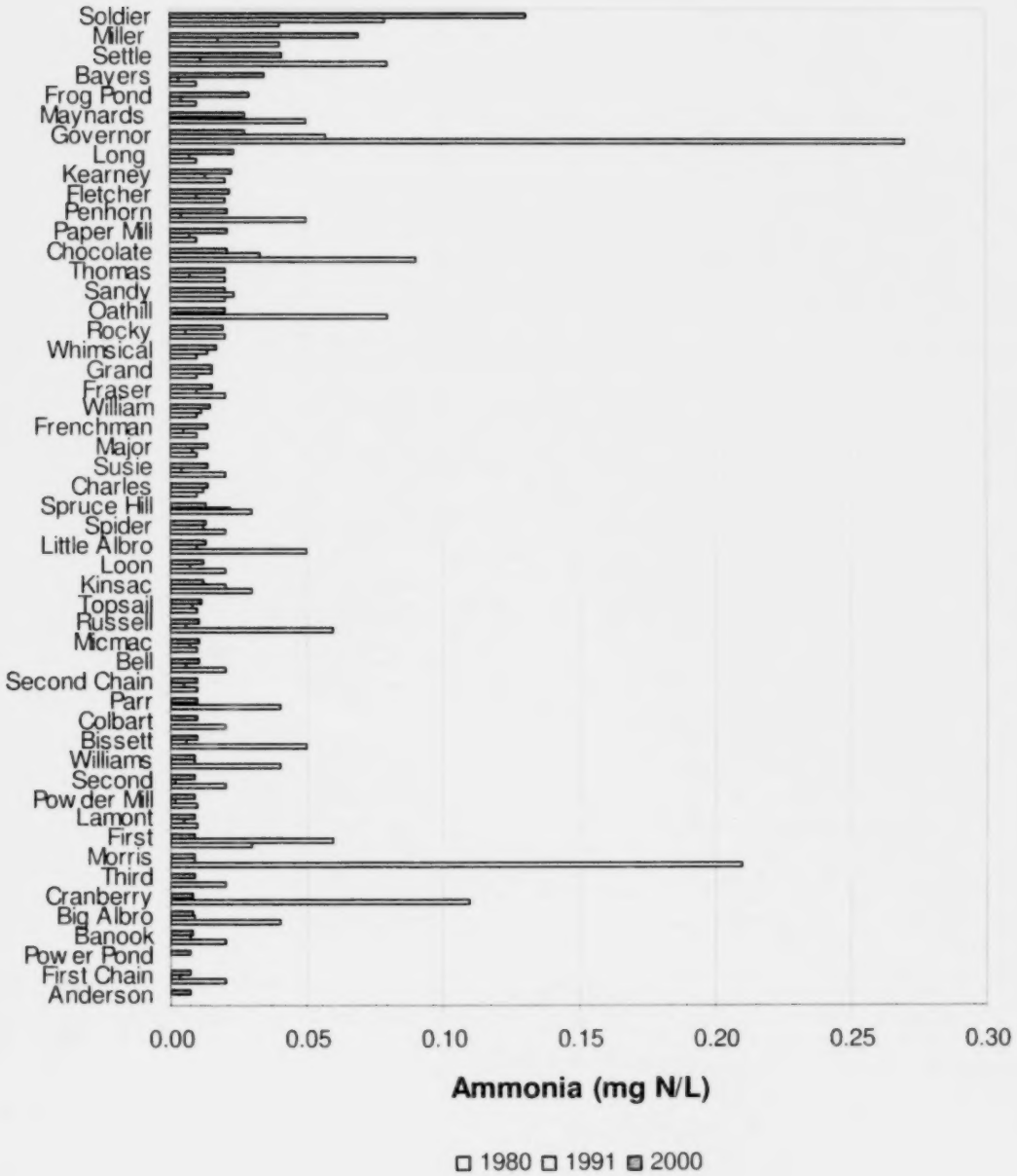

Figure 13. Average ammonia concentrations (mg N/L) for samples.

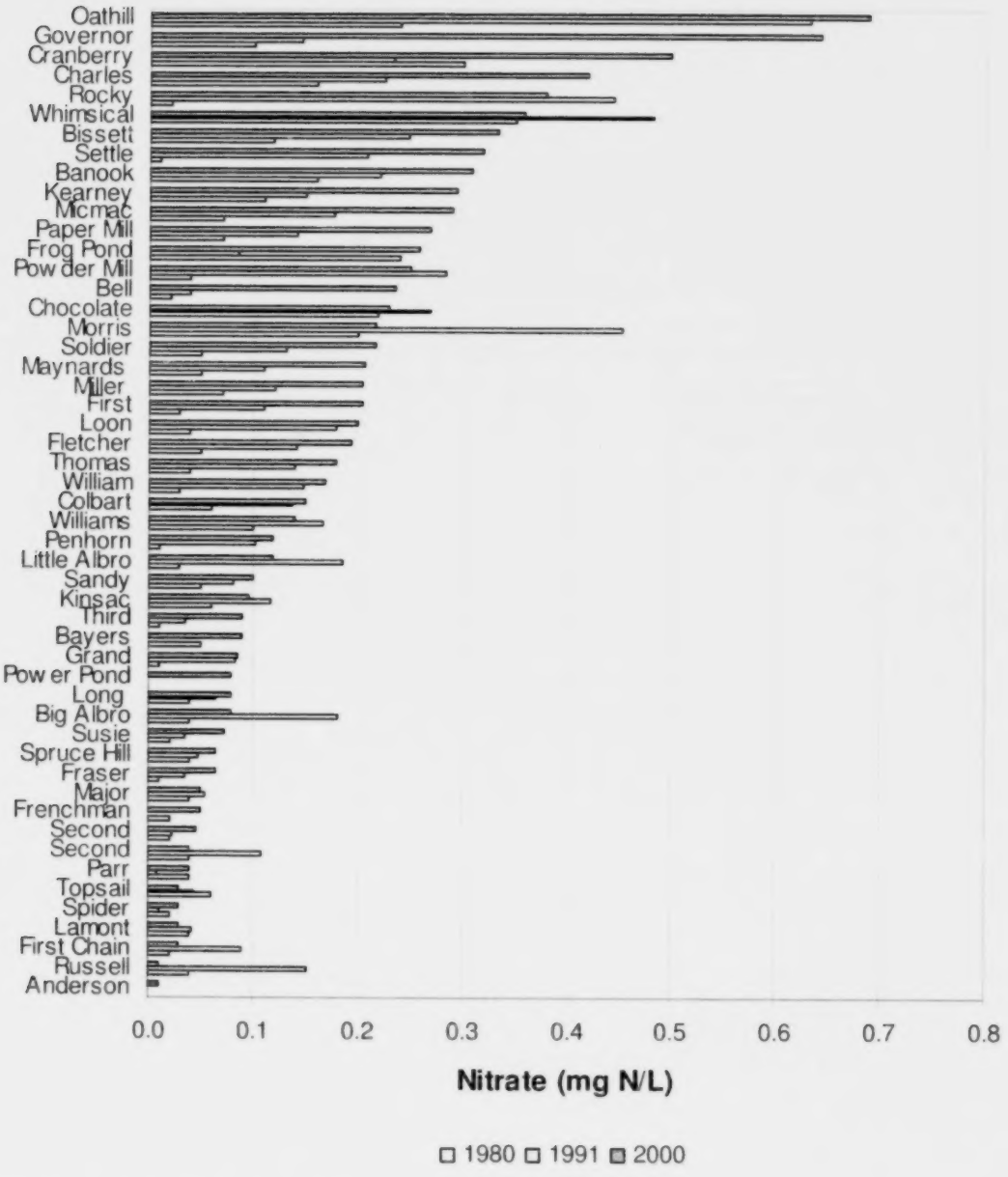

Figure 14. Average nitrate concentrations (mg N/L) for samples.

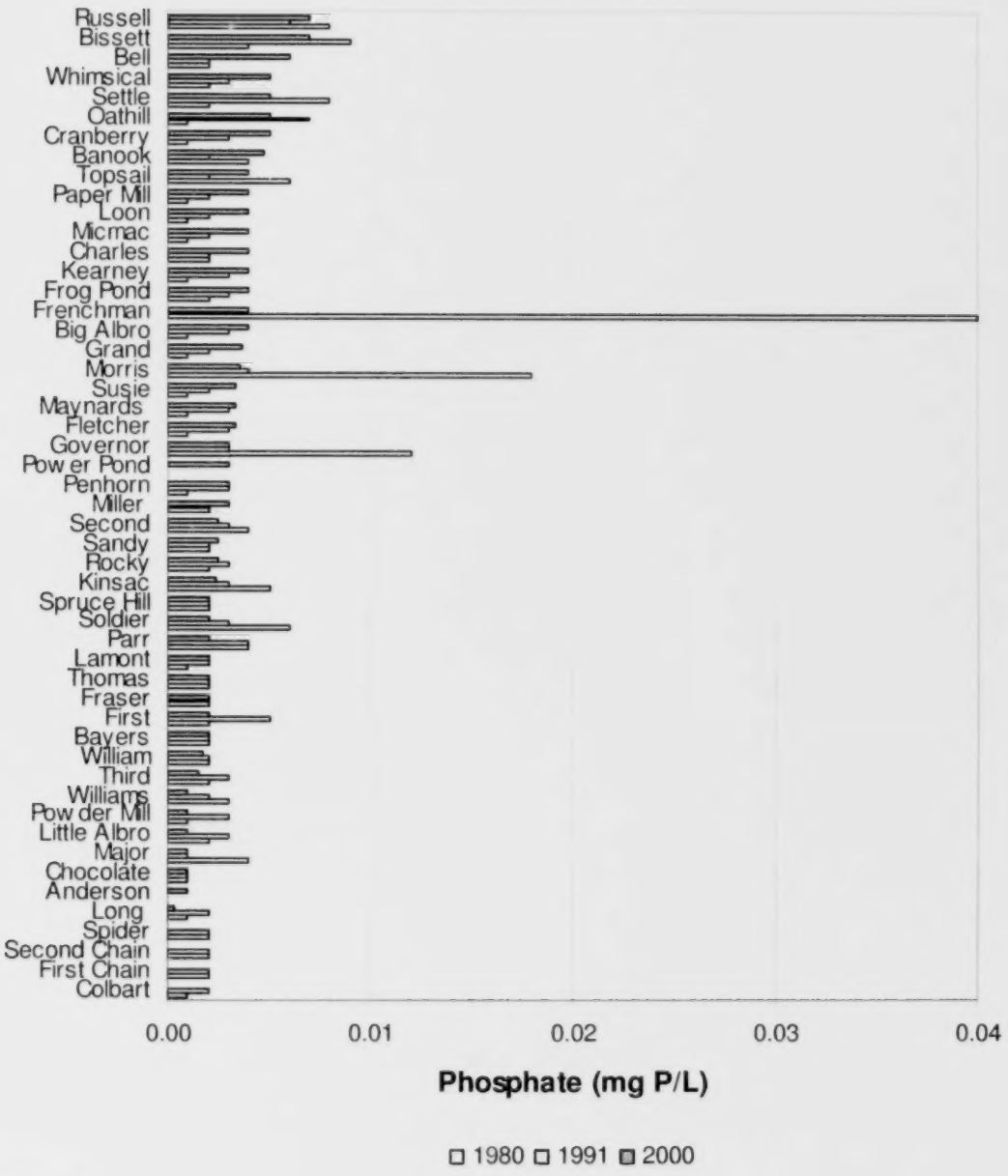

Figure 15. Average phosphate concentrations (mg P/L) for samples.

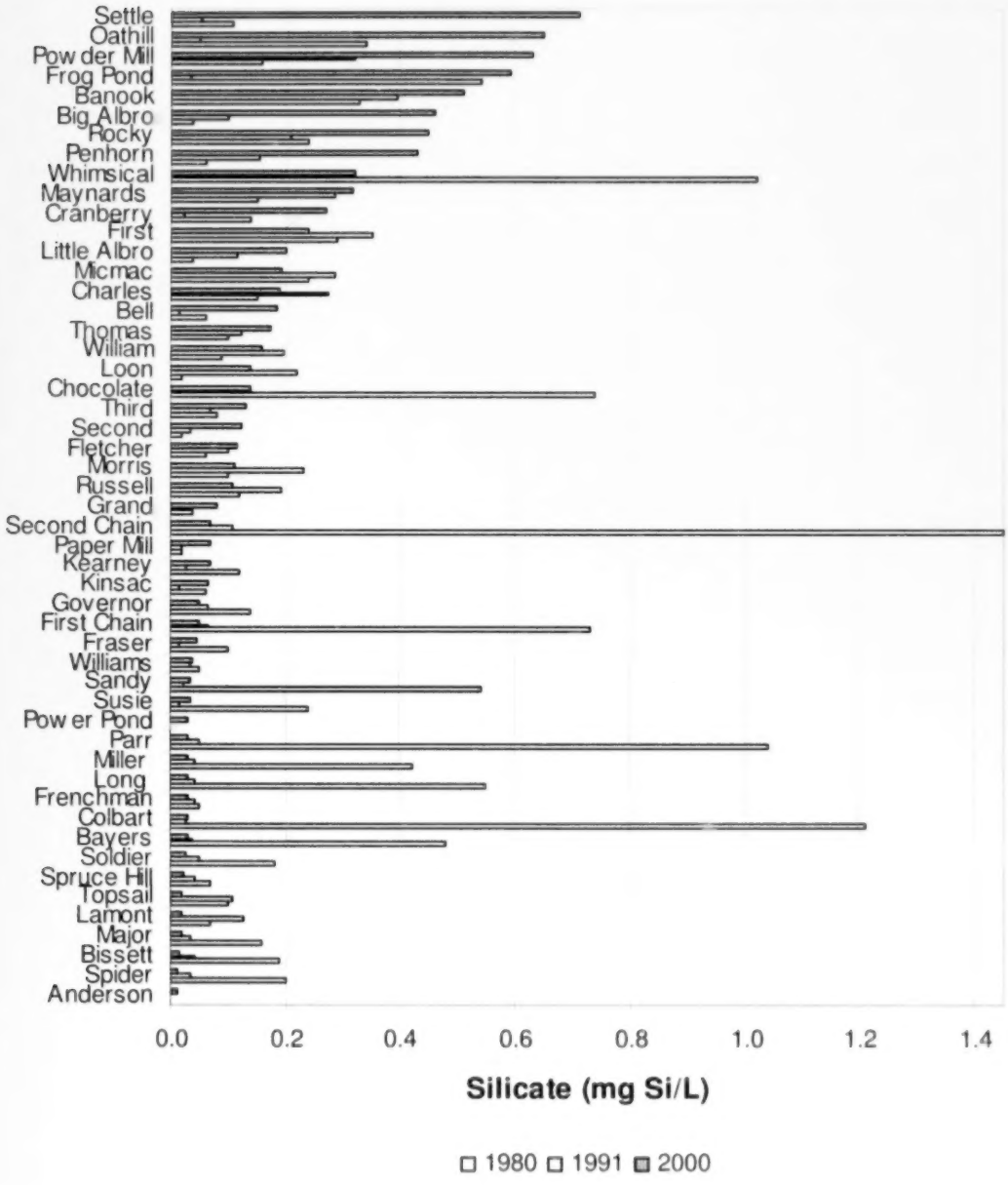

Figure 16. Average silicate concentrations (mg Si/L) for samples.

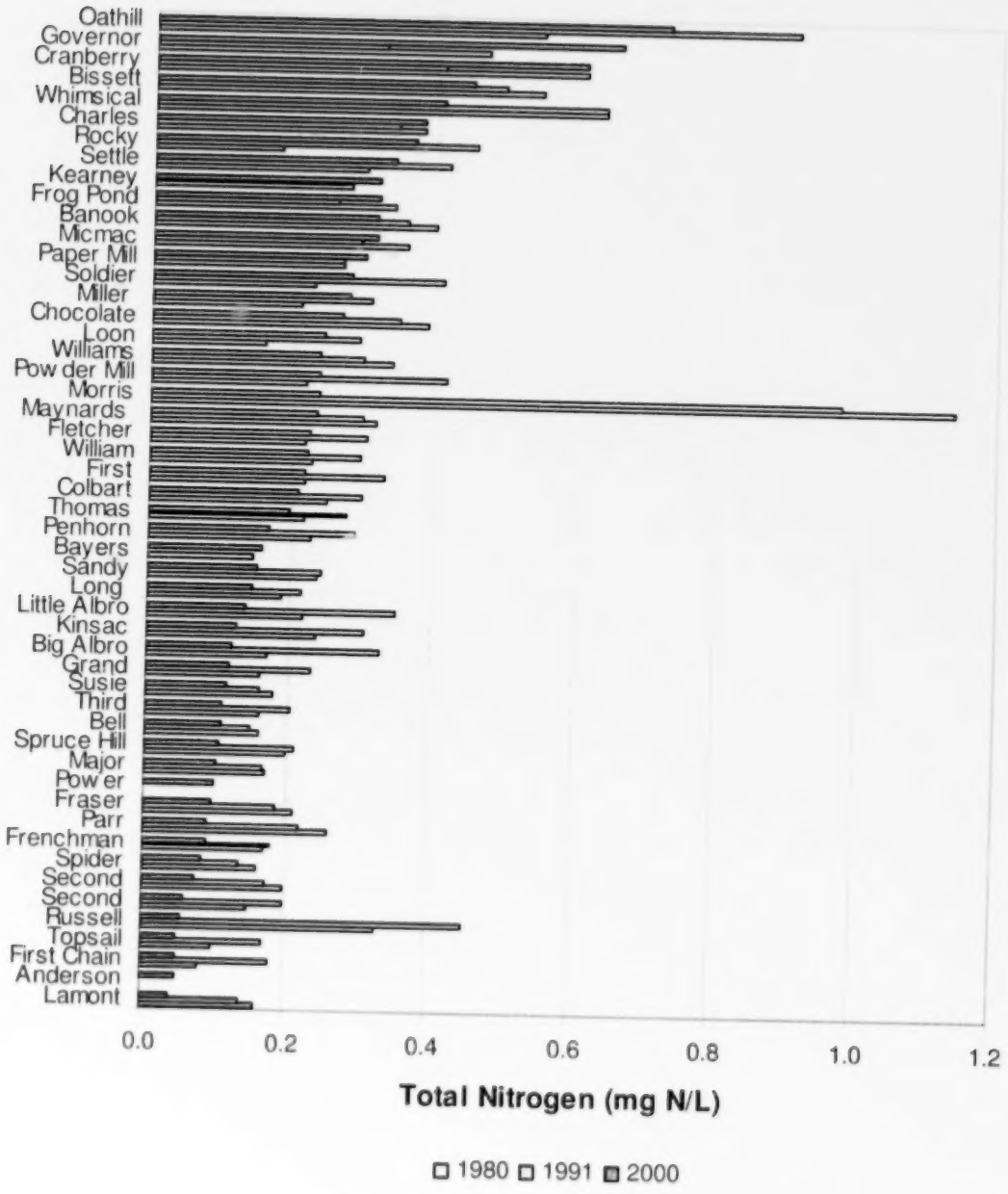

Figure 17. Average total nitrogen (TN) in mg/L for samples.

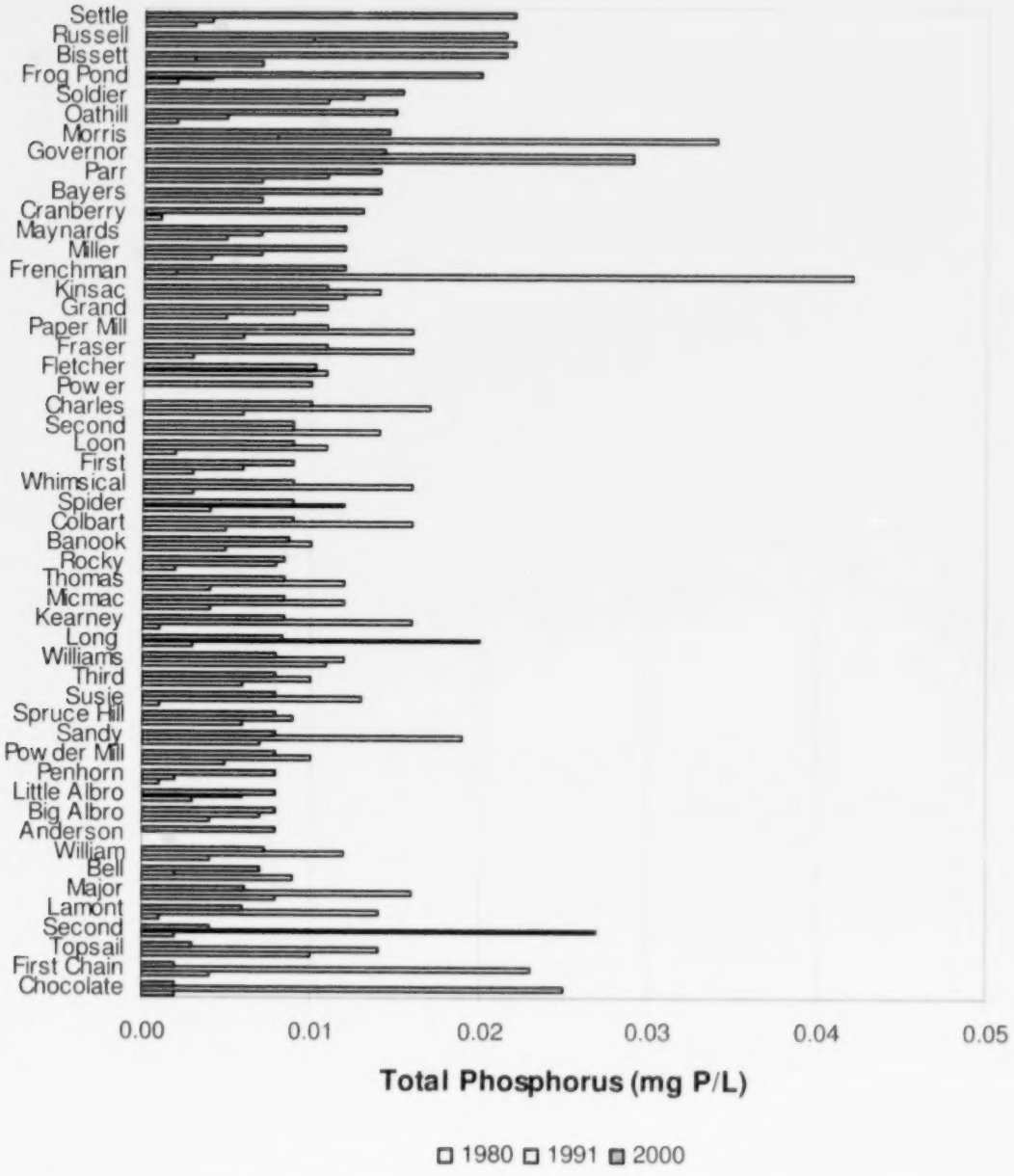

Figure 18. Average total phosphorus (TP) in mg/L for samples.

Organic Matter

Chlorophyll is a pigment produced by plants which plays a critical role in photosynthesis. It has been shown to be a good indicator of phytoplankton biomass. Because of low nutrient concentrations, Metro Area lakes have naturally low levels of phytoplankton biomass (and productivity) and are therefore classified at oligotrophic. As nutrient enrichment takes place due to anthropogenic activity, chlorophyll concentrations can be expected to increase as well.

Chlorophyll concentrations are plotted in Fig. 19. The highest concentrations occurred in Bissett, and Russell Lakes. Not surprisingly, these two lakes also had the highest concentrations of phosphate (Fig. 15). Concentrations tended to be greater in lakes with well-developed watersheds. Phosphate usually is the limiting nutrient in fresh water.

Dissolved organic carbon (DOC) is a direct measure of all organic substances in water that pass though a filter. Under natural conditions, it includes humic materials as well as exudates from phytoplankton and rooted aquatic vegetation. DOC in Metro Area lakes ranges from about 1 to 8 mg L^{-1} (Fig. 20). These levels are thought to reflect natural conditions. The DOC concentrations measured in 2000 are generally higher in all lakes compared to 1991. This is due to a change in methods from wet oxidation to dry combustion. The older wet oxidation method underestimated DOC by about 20-40% (Koprivnjak et al. 1994).

The yellow-brown colour found in many Metro Area lakes is due primarily to the presence of dissolved humic materials. These large organic molecules are produced naturally by vegetation growing in watershed areas, especially in acid bogs. Lake colour varied over a very large range from the very clear waters of Lakes Banook and Charles to the highly coloured waters of Colbart, Parr, and Long Lakes (Fig. 21). As expected, lakes with high colour also have high DOC concentrations since both methods are measuring the same substances ($r^2 = 0.77$).

The concentrations of dissolved organic carbon measured in 2000 are generally higher in all lakes comparted to 1991. This is due to a change in methods from wet oxidation to dry combustion. The older wet oxidation method underestimated DOC on the order of 20-40% (Koprivnjak et al. 1994).

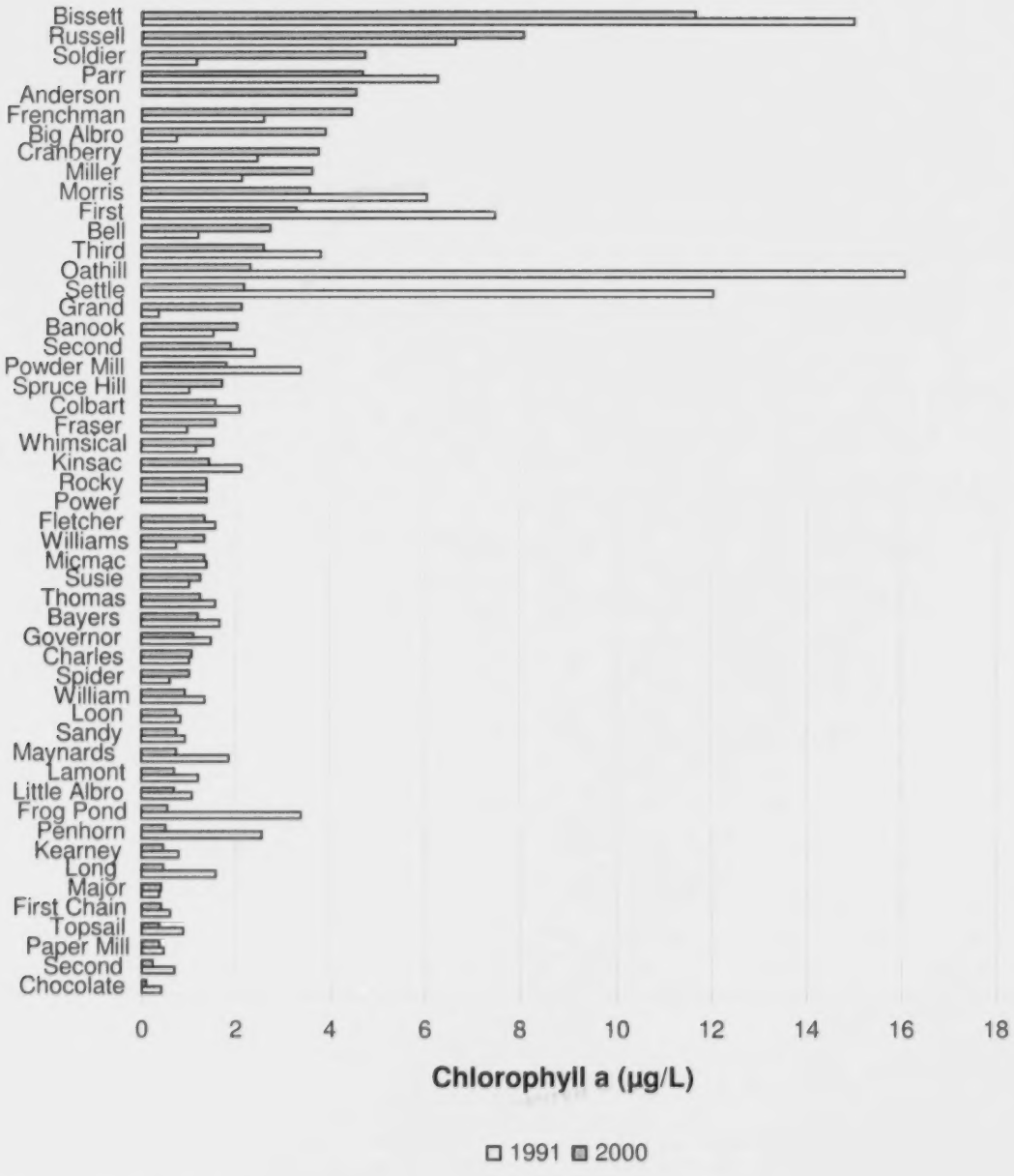

Figure 19. Average chlorophyll a concentrations (µg/L) for samples.

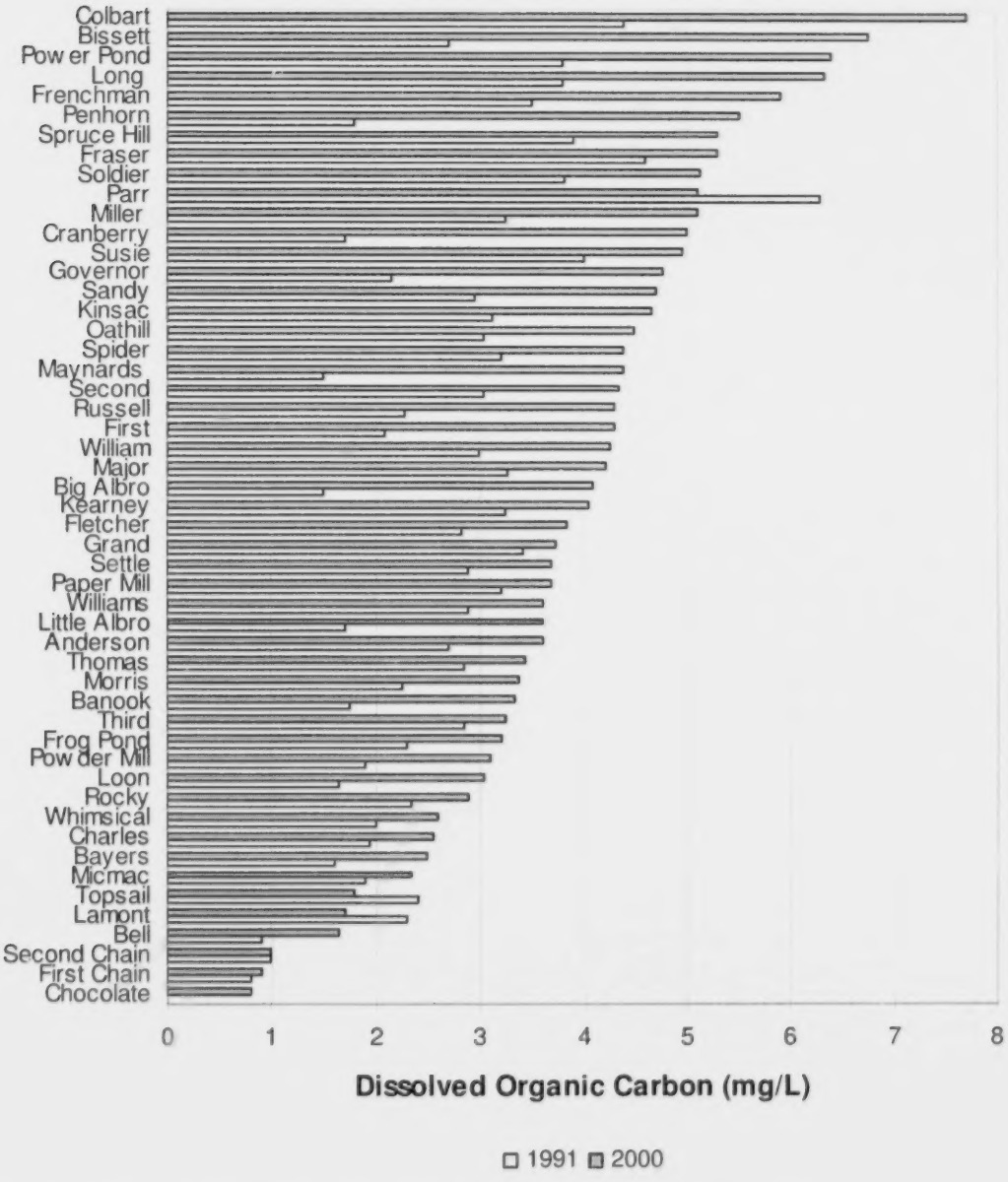

Figure 20. Average dissolved organic carbon concentrations (mg C/L) for samples.

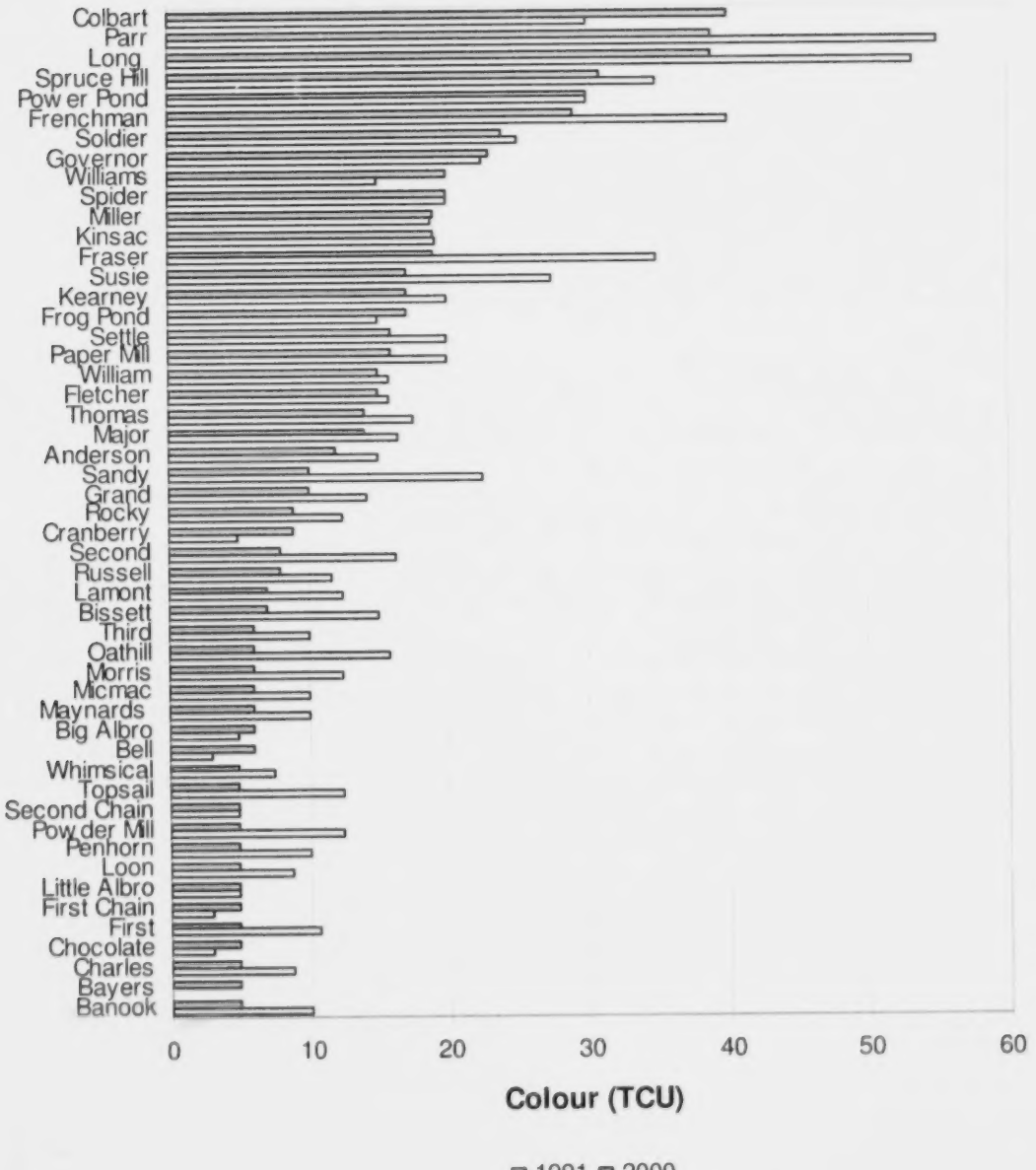

Figure 21. Average colour values (TCU) for samples.

Elements

The full data set of elemental analysis conducted by Natural Resources Canada is presented in Appendix D for 1991 and Appendix E for 2000. A detailed analysis and interpretation of these data is beyond the scope of this report. However, it should be noted that values of aluminium in First and Second Chain Lakes (777 and 923 ug/L) are much higher than observed in other lakes. They are also much higher than detected by Environment Canada in the same two lakes (Fig. 9) suggesting they may be in error.

Trophic Status Index

Lakes can be classified on the basis of their general level of biological production. Oligotrophic (poorly fed) lakes are low in nutrients, low in plant biomass, and maintain high oxygen levels in deep water. Eutrophic (well fed) lakes are rich in nutrients, high in plant biomass, and can have markedly reduced oxygen levels in deep water during the summer months. Lakes with intermediate conditions are called mesotrophic. The progression from an oligotrophic to eutrophic condition is a natural process called eutrophication. Lakes in the Metro Area are naturally oligotrophic but the addition of anthropogenic nutrients, especially phosphorus, is accelerating the eutrophication process.

The lakes in the Metro Area are widely used for recreation and it is from this perspective that most people view water quality. They want lakes which have clean shorelines, clear water, and support desirable species such as trout and loons. Such lakes generally fall into the oligotrophic category. As lakes become more enriched with nutrients, their attractiveness for recreation decreases as plant abundance increases and water clarity decreases. Therefore it is important to monitor the trophic status of Metro Area lakes so that corrective action can be taken if nutrient conditions become, or are predicted to become, unacceptable.

Values for trophic status index (TSI), calculated using chlorophyll, are plotted in Fig. 22. Values in excess of 50 are generally considered to indicate eutrophic conditions. In 1991, four lakes met this condition (Oathill, Bissett, Settle and First). In 2000, two lakes met this condition (Bissett and Russell). These are all lakes with well-developed watersheds. Lakes with the lowest values for TSI included First Chain, Second Chain, Chocolate, Paper Mill, Topsail and Major. All of these have relatively undeveloped watersheds.

TSI can also be estimated using total phosphorus. The highest values in 2000 were observed in Settle, Russell and Bissett Lakes plus the Frog Pond (Fig.18). According to CCME Guidelines, these would be classified as meso-eutrophic. Metro Area lakes with high concentrations of both total phosphorus and chlorophyll warrant close attention.

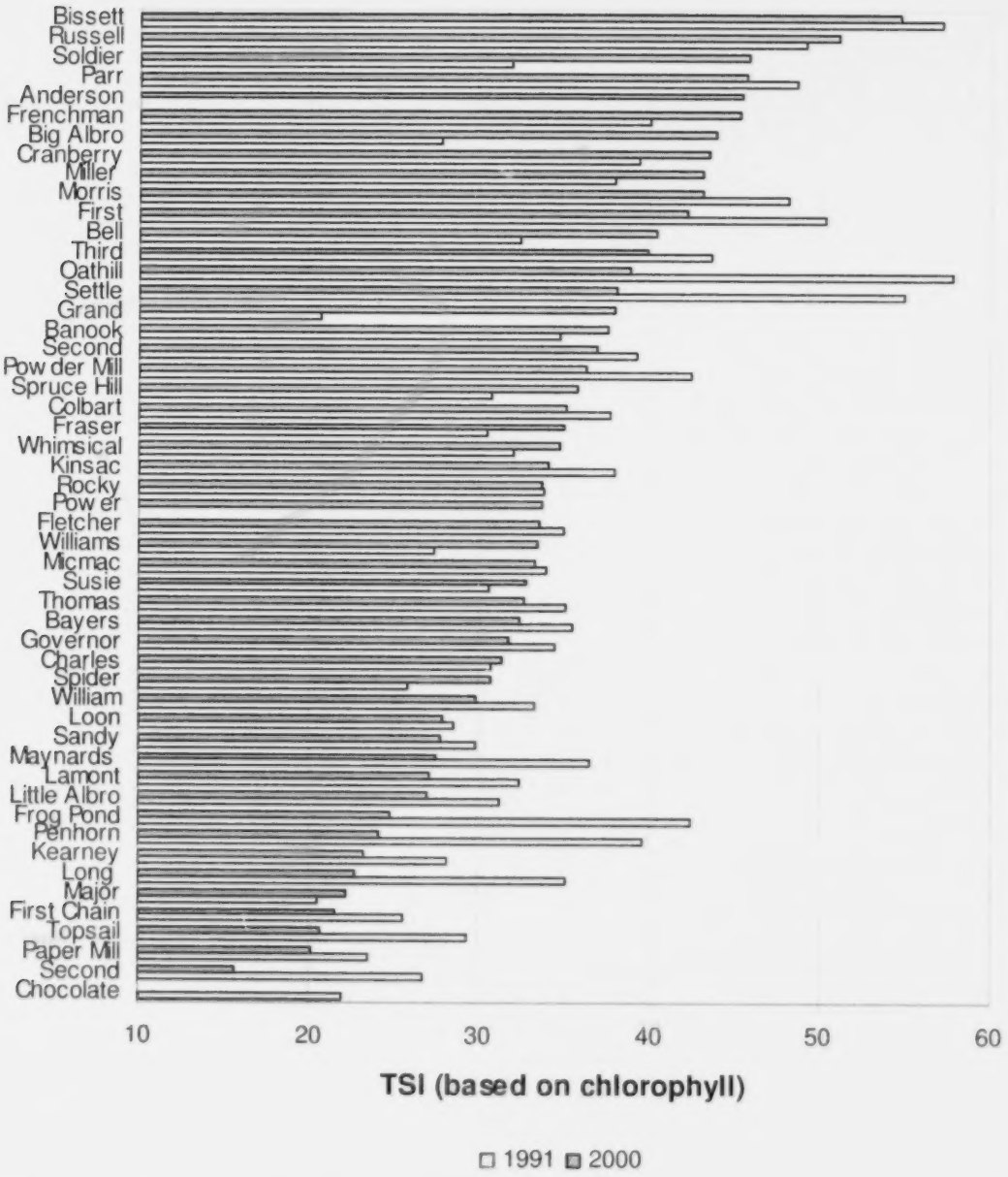

Figure 22. TSI values based on average chlorophyll concentrations for samples.

SUMMARY

The pH data base generated in this study is not sensitive enough to detect changes over the 20 year observation period (Table 4). However, other more carefully designed studies indicate that emission control measures on sulphate are having an effect and that Nova Scotian lakes are beginning to show signs of recovery from acid rain (Clair et al. 2003). Most of the Metro Area lakes do not suffer from acidification problems because of the buffering capacity offered by other dissolved contaminants. Gran alkalinity appears to have increased over the 20 year observation period (Table 4).

There has been a definite increase in conductivity in most if not all Metro Area lakes over the 20 year observation period, especially between 1980 and 1991 (Table 4). The major ions causing this increase are sodium, chloride, and calcium. If these increases were the result of natural processes of rock weathering and sea salt input, they would tend to be consistent in all lakes (but with some variation related to watershed size and distance from the coast). Instead, increases were greatest in those lakes having well developed watersheds and least in those lakes having watersheds with a large amount of terrain still in a natural state. Therefore, these increases must be due to the increased use of sodium, chloride, and calcium in the developed parts of the Metro Area. The prime source is road salt (sodium chloride) which is used for de-icing purposes during the winter months. Other likely sources include calcium chloride, which is used for dust control on unpaved streets, and agricultural lime.

This increase in conductivity does not constitute a serious environmental impact but does warrant concern and continued investigation. Sodium, chloride, and calcium are all naturally occurring substances that are not toxic to life at the present concentrations found in Metro Area lakes (which are much less than concentrations found in seawater and human blood). The concern is that dissolved ions do influence the density of water and if concentrations do get high enough they could interfere with the normal spring and fall mixing events that are essential to maintain lake water quality. No corrective action seems necessary at this time but it obviously would be prudent to take preventative action by limiting the use of the responsible chemicals as much as practical.

The only nutrient that appears to be increasing over the 20 year observation period is nitrate (Table 4). Overall, the nutrient levels in Metro Area lakes continue remain to relatively low and only a few lakes appear to fall into the eutrophic category. Chlorophyll concentrations also remain relatively low. Metro Area lakes do not receive raw sewage directly but can be affected by occasional overflow events from combined sewers or treatment plant bypasses during major rain events, improper connections or faulty septic fields. It is expected that the use of lawn and garden fertilizers will increase the nutrient concentrations of lakes in developed watersheds over time. Wherever possible, steps should be taken to limit the human input of nutrients to the lakes, especially phosphorus. These could include public education programs, periodic testing of private septic systems, retention of natural vegetation around lakes, and protection of freshwater wetlands.

The results of this study indicate that the water quality of Metro Area lakes in 2000 remains in

general at a relatively good level. Most if not all the lakes do show the impacts of human activity, especially in well developed watersheds, but these impacts do not appear to have a major impact on biological processes. The only exception to this appears to be lakes where acid precipitation or runoff from acid slates has decreased pH to levels injurious to some organisms. The only significant long term changes observed in this study are increases in conductivity, major ions, Gran alkalinity and nitrate.

It should be emphasized that this study has only considered of selected number of water quality variables because of the limits of time and funding. It has not measured other important contaminants such as silt, micro-organisms and synthetic organic compounds (herbicides, pesticides, etc.). In addition, it has not considered other potential environmental problems such as chemical contaminants in lake sediments, changes in the species composition of biological communities, and increases in rooted aquatic vegetation. Therefore, there may be additional environmental concerns associated with Metro Area lakes that are not covered by this report.

It is our intent to repeat this survey in 2010 if resources are available.

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REFERENCES

American Public Health Assoc. 1998. Standard Methods for water and wastewater, 20th Edition

Carlson, R.E. 1977. A trophic status index for lakes. Limnol. Oceanogr. 22:361-369.

Castell, C. H., I. Novaczek and J.D. Castell. 1984 A study of the acidity of three Dartmouth, Nova Scotia lakes 1: The pH of precipitation falling on Micmac Lake. Can. Tech. Rept. Fish. Aquat. Sci. 1231.

Clair, T.A., I.F. Dennis and B.J. Cosby. 2003. Probable changes in lake chemistry in Canada's Atlantic Provinces under proposed North American emission reductions. Hydrology and Earth System Sciences 7: 574-582.

Environment Canada 1979. Analytical Methods Manual, Inland Waters Directorate, Water Quality Branch

Gordon, D.C. Jr. 1977. A Secchi disk study of Dartmouth's lakes, 1976 – Citizen involvement in water quality measurements. Bedford Institute of Oceanography Report BI-R-77-2.

Gordon, D.C. Jr. 1978. Secchi disk observations in Dartmouth's Lakes. Bedford Institute of Oceanography Report BI-R-78-2.

Gordon, D.C. Jr., P.D. Keizer, J.G. Ogden III, J. Underwood and J.F. Wiltshire. 1981. Synoptic water quality survey of fifty lakes in the Halifax, N.S. Metro Area on 14 April 1980. Bedford Institute of Oceanography Report BI-R-81-5.

Gorham, E. 1957. The chemical composition of lake waters in Halifax County, Nova Scotia. Limnol. Oceanogr. 2:12-21.

Hellenbrand, K. and F. Dalziel. 1992. Dartmouth Lakes Advisory Board Rep., 8 p.

Holm-Hansen, O., Lorenzen, C.J., Holmes, R.W., Strickland, J.D.H. 1965. Fluorometric determination of chlorophyll. J. Cons. Int. Expl. Mer. 30: 1-15.

Keizer, P.D., D.C. Gordon, Jr., T.W. Rowell, R. McCurdy, D. Borgal, T.A. Clair, D. Taylor, J.G.Ogden, III, and G.E.M. Hall. 1993. Synoptic water quality survey of Halifax/Dartmouth Metro Area lakes on April 16, 1991. Can. Data Rept. Fish. Aquat. Sci. 914.

Koprivnjak, J-F., J.G. Blanchette, R.A. Bourbonniere, T.A. Clair, A. Heyes, K.R. Lum, R McCrea and T.R. Moore. 1994. The underestimation of concentrations of dissolved organic carbon in freshwaters. Water Research 29:91-94.

Ogden, J.G. III. 1972. Water quality survey of selected metropolitan area lakes. Report prepared for Metropolitan Area Planning Committee (MAPC).

Scott, R.S., W.C. Hart, and D.H. Waller. 1991. Water quality in the headwaters of the

Shubenacadie River system. Technical University of Nova Scotia, Centre for Water Resource Studies: 17 p.

Soil and Water Conservation Society of Metro Halifax. 1991. Limnological study of twenty-seven Halifax Metro lakes: 135 p.

Strain, P.M and P.M Clement. Nutrient and dissolved oxygen concentrations in the Letang Inlet, New Brunswick, in the summer of 1994. Can.Data Rep. Fish. Aquat. Sci. 1004:iv+33p.

Watt, W.D., D. Scott and S. Ray. 1979. Acidification and other chemical changes in Halifax County Lakes after 21 years. Limnol. Oceanogr. 24: 1154-1161.

APPENDIX A - Data Collected in 1980

An electronic copy of these data can be obtained from the Halifax Regional Municipality at XXXX

Table 6. Data for lake samples collected in 1980, averages only.

	Anderson	*Banook*	*Bayers*	*Bell*	*Big Albro*	*Bissett*	*Charles*	*Chocolate*	*Colbart*
Gran alkalinity (mg $CaCO_3$/L)		9.05	0.05	1.20	3.80	11.69	2.84	0.15	0.05
Calcium (mg Ca/L)		11.0	3.2	1.8	5.2	12.0	4.0	12.4	3.4
Chloride (mg Cl/L)		55.0	44.0	58.0	32.0	77.0	20.5	113.0	10.0
Conductivity (µS)		196.2	148.5	38.0	105.0	241.8	82.4	346.0	108.8
Potassium (mg K/L)		1.2	1.0	0.6	0.7	2.0	0.8	1.5	0.8
Magnesium (mg Mg/L)		0.2	1.4	1.0	1.0	1.9	1.2	2.0	1.0
Sodium (mg Na/L)		31.5	24.0	4.6	20.0	40.0	13.0	70.0	21.0
Ammonia (mg N/L)		0.020	0.010	0.020	0.040	0.050	0.010	0.090	0.020
Nitrate (mg N/L)		0.16	0.05	0.02	0.04	0.12	0.16	0.22	0.06
pH		6.97	4.63	5.81	6.82	6.98	6.48	5.33	4.87
Phosphate (mg P/L)		0.004	0.002	0.002	0.001	0.004	0.002	0.001	0.001
Silicate (mg Si/L)		0.33	0.48	0.06	0.04	0.19	0.15	0.74	1.21
Sulphate (mg SO_4/L)		6.4	4.7	2.8	4.2	6.4	4.0	11.3	4.0
Theoretical Conductivity (µS)		234.1	176.3	43.1	139.5	312.1	96.8	452.8	146.8
Temperature (°C)		6.0		4.5	6.2	6.0	4.0	7.0	7.0
Total Nitrogen (mg N/L)		0.40	0.15	0.16	0.17	0.55	0.38	0.39	0.25
Total Phosphorus (mg P/L)		0.005	0.007	0.009	0.004	0.007	0.006	0.002	0.005

Table 5-2. Data for individual lake samples collected in 1980, averages only.

	Cranberry	*First*	*First Chain*	*Fletcher*	*Fraser*	*Frenchman*	*Frog Pond*	*Governor*	*Grand*
Gran alkalinity (mg $CaCO_3$/L)	12.00	13.04	0.00	1.72	0.05	0.00	13.00	1.50	1.53
Calcium (mg Ca/L)	10.6	13.4	5.6	3.3	0.8	1.2	21.4	3.8	5.9
Chloride (mg Cl/L)	6.0	23.0	49.0	18.2	29.5	3.8	125.0	4.5	9.3
Conductivity (µS)	101.8	219.0	189.0	70.3	34.5	31.0	426.5	97.0	56.2
Potassium (mg K/L)	1.5	1.8	0.8	0.6	0.4	0.5	2.2	1.0	0.4
Magnesium (mg Mg/L)	1.7	1.7	1.9	0.8	0.5	0.6	2.3	1.0	0.7
Sodium (mg Na/L)	15.0	40.0	30.0	10.7	4.7	2.3	73.0	18.0	5.7
Ammonia (mg N/L)	0.110	0.030	0.020	0.020	0.020	0.010	0.010	0.270	0.010
Nitrate (mg N/L)	0.30	0.03	0.02	0.05	0.01	0.02	0.24	0.10	0.01
pH	6.81	6.97	4.48	6.27	4.80	4.64	6.80	5.84	6.20
Phosphate (mg P/L)	0.001	0.002	0.002	0.001	0.002	0.040	0.002	0.012	0.001
Silicate (mg Si/L)	0.14	0.29	0.73	0.06	0.10	0.05	0.54	0.14	0.04
Sulphate (mg SO_4/L)	5.7	6.9	7.7	3.2	2.0	2.8	12.7	4.1	4.9
Theoretical Conductivity (µS)	145.8	301.6	145.8	81.1	40.2	31.6	522.3	125.2	59.3
Temperature (°C)	5.1	5.2	4.5	6.0	4.2	7.0		5.3	4.0
Total Nitrogen (mg N/L)	0.61	0.22	0.08	0.22	0.21	0.17	0.34	0.47	0.16
Total Phosphorus (mg P/L)	0.001	0.003	0.004	0.011	0.003	0.042	0.002	0.029	0.005

Table 5-3. Data for individual lake samples collected in 1980, averages only.

	Kearney	*Kinsac*	*Lamont*	*Little Albro*	*Long*	*Loon*	*Major*	*Maynards*	*Micmac*
Gran alkalinity (mg $CaCO_3$/L)	0.70	1.85	0.30	4.68	0.05	2.85	0.07	9.20	7.04
Calcium (mg Ca/L)	1.6	1.9	2.7	6.1	1.2	5.8	0.8	11.6	9.6
Chloride (mg Cl/L)	5.2	8.1	5.0	75.0	36.0	6.1	30.5	91.0	47.0
Conductivity (µS)	49.5	39.2	33.2	109.0	74.2	108.2	30.9	212.0	159.2
Potassium (mg K/L)	0.6	0.7	0.3	0.8	0.5	1.0	0.3	1.5	1.0
Magnesium (mg Mg/L)	0.7	0.7	0.6	1.0	0.8	0.7	0.5	2.4	1.4
Sodium (mg Na/L)	8.4	4.8	3.8	22.0	12.0	17.5	3.4	42.0	27.0
Ammonia (mg N/L)	0.020	0.030	0.010	0.050	0.010	0.020	0.010	0.050	0.010
Nitrate (mg N/L)	0.11	0.06	0.04	0.03	0.04	0.04	0.04	0.05	0.07
pH	5.60	6.08	6.58	6.77	4.60	6.70	4.80	6.97	6.88
Phosphate (mg P/L)	0.001	0.005	0.001	0.002	0.001	0.001	0.004	0.001	0.001
Silicate (mg Si/L)	0.12	0.06	0.07	0.04	0.55	0.02	0.16	0.15	0.24
Sulphate (mg SO_4/L)	2.2	2.3	2.5	4.5	3.2	4.9	2.1	5.8	5.7
Theoretical Conductivity (µS)	60.7	42.0	156.1	156.1	89.2	132.2	31.5	309.0	205.3
Temperature (°C)	3.9	4.5	4.5	6.4	5.5	6.0		5.6	6.0
Total Nitrogen (mg N/L)	0.28	0.24	0.16	0.22	0.19	0.16	0.17	0.32	0.36
Total Phosphorus (mg P/L)	0.001	0.012	0.001	0.003	0.003	0.002	0.008	0.005	0.004

Table 5-4. Data for individual lake samples collected in 1980, averages only.

	Miller	*Morris*	*Oathill*	*Paper Mill*	*Parr*	*Penhorn*	*Powder Mill*	*Power Pond*	*Rocky*
Gran alkalinity (mg $CaCO_3$/L)	0.07	6.64	18.00	0.65	0.40	22.00	7.30		8.45
Calcium (mg Ca/L)	2.2	7.2	17.8	1.6	1.8	16.8	5.5		6.9
Chloride (mg Cl/L)	20.3	41.7	84.0	14.0	32.0	8.3	33.0		14.0
Conductivity (µS)	71.6	151.5	280.0	47.5	47.5	253.5	83.5		111.9
Potassium (mg K/L)	0.5	1.3	2.5	0.6	0.6	1.4	0.9		1.1
Magnesium (mg Mg/L)	0.8	1.5	2.7	0.7	0.8	1.9	0.9		1.0
Sodium (mg Na/L)	11.5	24.0	53.0	8.1	6.0	46.0	14.0		19.4
Ammonia (mg N/L)	0.040	0.210	0.080	0.010	0.040	0.050	0.010		0.020
Nitrate (mg N/L)	0.07	0.20	0.24	0.07	0.04	0.01	0.04		0.02
pH	5.00	6.84	7.02	5.70	4.76	7.20	6.68		6.74
Phosphate (mg P/L)	0.002	0.018	0.001	0.001	0.004	0.001	0.001		0.002
Silicate (mg Si/L)	0.42	0.10	0.34	0.02	1.04	0.06	0.16		0.24
Sulphate (mg SO_4/L)	3.3	5.6	9.5	2.2	3.3	6.2	2.9		3.8
Theoretical Conductivity (µS)	86.3	181.6	399.2	59.2	54.6	360.0	109.4		149.1
Temperature (°C)	5.4	6.0	5.5	5.0	6.5	5.9	6.0		7.1
Total Nitrogen (mg N/L)	0.21	1.14	0.55	0.27	0.26	0.23	0.22		0.18
Total Phosphorus (mg P/L)	0.004	0.034	0.002	0.006	0.007	0.001	0.005		0.002

Table 5-5. Data for individual lake samples collected in 1980, averages only.

	Russell	*Sandy*	*Second*	*Second Chain*	*Settle*	*Soldier*	*Spider*	*Spruce Hill*	*Susie*
Gran alkalinity (mg $CaCO_3$/L)	11.91	0.05	2.15	0.00	11.00	0.08	0.05	0.08	0.05
Calcium (mg Ca/L)	11.4	1.8	2.9	5.8	11.6	1.1	0.8	0.3	0.5
Chloride (mg Cl/L)	80.0	13.7	70.0	66.0	27.0	7.7	5.1	3.9	7.9
Conductivity (µS)	247.5	58.9	43.1	231.0	200.0	45.0	26.6	29.3	27.1
Potassium (mg K/L)	1.8	0.7	0.6	0.9	1.8	0.3	0.2	0.2	0.3
Magnesium (mg Mg/L)	1.7	0.9	0.8	1.7	1.9	0.7	0.5	0.5	0.4
Sodium (mg Na/L)	47.0	8.4	5.7	38.0	33.0	4.6	2.5	3.2	3.0
Ammonia (mg N/L)	0.060	0.020	0.020	0.010	0.080	0.040	0.020	0.030	0.020
Nitrate (mg N/L)	0.04	0.05	0.02	0.04	0.01	0.05	0.02	0.04	0.02
pH	6.81	4.90	6.28	4.51	7.02	4.59	5.93	4.56	4.75
Phosphate (mg P/L)	0.008	0.002	0.004	0.002	0.002	0.006	0.002	0.002	0.001
Silicate (mg Si/L)	0.12	0.54	0.02	1.45	0.11	0.18	0.20	0.07	0.24
Sulphate (mg SO_4/L)	6.4	3.9	2.0	6.9	6.4	3.4	1.9	1.8	1.8
Theoretical Conductivity (µS)	331.1	67.8	53.0	267.0	254.6	46.7	21.4	33.0	29.9
Temperature (°C)	6.0	4.0	5.5	4.5	4.5	4.0	4.0	6.0	5.8
Total Nitrogen (mg N/L)	0.33	0.24	0.20	0.15	0.30	0.23	0.16	0.20	0.18
Total Phosphorus (mg P/L)	0.022	0.007	0.014	0.002	0.003	0.011	0.004	0.006	0.001

Table 5-6. Data for individual lake samples collected in 1980, averages only.

	Third	*Thomas*	*Topsail*	*Whimsical*	*William*	*Williams*
Gran alkalinity (mg $CaCO_3$/L)	3.40	3.64	3.90	17.00	3.40	1.33
Calcium (mg Ca/L)	3.2	3.9	2.8	24.4	3.8	4.2
Chloride (mg Cl/L)	11.3	20.0	5.0	108.0	18.4	46.0
Conductivity (µS)	49.4	77.2	36.9	376.0	71.8	136.0
Potassium (mg K/L)	0.6	0.6	0.4	2.7	0.7	1.0
Magnesium (mg Mg/L)	0.8	0.9	0.6	2.6	0.9	1.1
Sodium (mg Na/L)	7.0	12.8	3.7	63.0	11.0	26.0
Ammonia (mg N/L)	0.020	0.020	0.010	0.010	0.010	0.040
Nitrate (mg N/L)	0.01	0.04	0.06	0.35	0.03	0.10
pH	6.46	6.53	6.81	6.82	6.61	5.93
Phosphate (mg P/L)	0.002	0.002	0.006	0.002	0.002	0.003
Silicate (mg Si/L)	0.08	0.10	0.10	1.02	0.09	0.05
Sulphate (mg SO_4/L)	2.2	3.2	2.3	14.3	3.2	4.7
Theoretical Conductivity (µS)	61.4	92.9	38.3	480.6	85.3	179.5
Temperature (°C)	4.8	5.0	5.0		4.0	7.4
Total Nitrogen (mg N/L)	0.16	0.22	0.10	0.64	0.23	0.34
Total Phosphorus (mg P/L)	0.006	0.004	0.010	0.003	0.004	0.011

APPENDIX B - Data Collected in 1991

An electronic copy of these data can be obtained from the Halifax Regional Municipality at XXXX

Table 7. Data for individual lake samples collected in 1991, averages only.

	Anderson	*Banook*	*Bayers*	*Bell*	*Big Albro*	*Bissett*	*Charles*	*Chocolate*	*Colbart*
Temperature (°C)	7.0	7.5	7.5	5.0	5.5	7.5	6.5	7.5	7.1
pH	5.32	6.78		5.00	6.38	6.69	6.68	4.68	5.62
Conductivity (µS)	63.5	357.8	270.0	56.4	335.0	608.0	195.5	509.0	275.0
Theoretical Conductivity (µS)	62.8	381.7		58.5	366.6	632.0	197.0	558.8	299.8
Sodium (mg Na/L)	7.6	56.2		4.6	56.7	94.5	27.0	80.3	47.5
Calcium (mg Ca/L)	2.0	10.1		2.6	8.4	15.4	6.5	10.6	5.2
Magnesium (mg Mg/L)	0.6	1.4		1.0	1.2	2.1	1.2	2.5	0.8
Potassium (mg K/L)	0.5	1.3		0.7	1.0	2.4	1.0	1.5	0.9
Chloride (mg Cl/L)	12.2	90.8		8.4	89.3	157.0	43.2	125.0	74.8
Sulphate (mg SO_4/L)	6.8	5.5		3.3	4.9	5.7	3.9	15.8	4.1
Gran alkalinity (mg $CaCO_3$/L)	0.00	9.58		0.00	4.20	18.50	6.55	0.00	0.50
Ammonia (mg N/L)	0.010	0.007	0.003	0.006	0.009	0.006	0.012	0.033	0.001
Nitrate (mg N/L)	0.01	0.22	0.00	0.04	0.18	0.25	0.23	0.27	0.14
Phosphate (mg P/L)	0.004	0.002	0.002	0.002	0.003	0.009	0.002	0.001	0.002
Silicate (mg Si/L)	0.02	0.40	0.04	0.02	0.10	0.04	0.27	0.12	0.03
Total Nitrogen (mg N/L)	0.13	0.36		0.15	0.33	0.50	0.35	0.35	0.30
Total Phosphorus (mg P/L)	0.015	0.010		0.002	0.007	0.003	0.017	0.025	0.016
Chlorophyll a (mg/L)	2.84	1.54	1.65	1.21	0.75	15.04	1.03	0.42	2.07
Colour (TCU)	15.0	10.0		3.0	5.0	15.0	8.8	3.0	30.0
DOC (mg C/L)	2.7	1.8	1.6	0.9	1.5	2.7	2.0		4.4

Table 7-2. Data for individual lake samples collected in 1991, averages only.

	Cranberry	*First*	*First Chain*	*Fletcher*	*Fraser*	*Frenchman*	*Frog Pond*	*Governor*	*Grand*
Temperature (°C)	6.0	6.9	6.9	7.3	5.8	10.0	8.5	6.5	4.4
pH	6.71	6.81	4.36	6.40	4.91	5.40	6.67	4.59	6.04
Conductivity (µS)	458.0	351.8	386.0	128.2	47.5	402.0	558.0	271.5	81.7
Theoretical Conductivity (µS)	496.2	374.3	413.1	129.0	47.3	437.5	614.4	292.2	80.1
Sodium (mg Na/L)	73.0	51.1	53.0	16.9	5.0	69.2	90.0	38.4	8.8
Calcium (mg Ca/L)	12.8	14.0	7.6	4.6	1.3	8.2	15.9	6.7	4.1
Magnesium (mg Mg/L)	1.9	1.9	2.5	0.8	0.5	1.5	1.8	1.8	0.7
Potassium (mg K/L)	2.0	1.9	1.0	0.8	0.5	1.0	2.2	1.1	0.6
Chloride (mg Cl/L)	120.0	82.1	87.0	28.0	8.5	110.0	148.0	58.9	14.1
Sulphate (mg SO_4/L)	6.3	5.6	14.7	2.9	1.7	5.2	9.5	10.6	3.2
Gran alkalinity (mg $CaCO_3$/L)	12.30	19.35	0.00	3.53	0.00	0.50	11.30	0.00	1.97
Ammonia (mg N/L)	0.007	0.060	0.003	0.010	0.010	0.005	0.004	0.057	0.015
Nitrate (mg N/L)	0.23	0.11	0.09	0.14	0.04	0.00	0.09	0.15	0.08
Phosphate (mg P/L)	0.003	0.005	0.002	0.003	0.002	0.002	0.003	0.003	0.002
Silicate (mg Si/L)	0.02	0.35	0.07	0.10	0.02	0.04	0.04	0.06	0.02
Total Nitrogen (mg N/L)	0.41	0.33	0.18	0.31	0.19	0.18	0.26	0.33	0.23
Total Phosphorus (mg P/L)	0.001	0.006	0.023	0.010	0.016	0.002	0.004	0.029	0.009
Chlorophyll a (mg/L)	2.45	7.49	0.60	1.57	0.99	2.61	3.37	1.50	0.36
Colour (TCU)	5.0	10.6	3.0	15.8	35.0	40.0	15.0	22.5	14.2
DOC (mg C/L)	1.7	2.1	0.8	2.8	4.6	3.5	2.3	2.2	3.4

Table 7-3. Data for individual lake samples collected in 1991, averages only.

	Kearney	*Kinsac*	*Lamont*	*Little Albro*	*Long*	*Loon*	*Major*	*Maynards*	*Micmac*
Temperature (°C)	5.5	5.5	6.0	6.0	6.1	7.5	5.0	6.0	7.3
pH	5.71	5.81	6.90	6.44	4.65	6.47	4.70	6.63	6.54
Conductivity (µS)	77.4	59.0	40.5	344.0	184.7	277.0	36.6	381.0	321.5
Theoretical Conductivity (µS)	78.0	57.8	41.9	374.2	193.5	287.2	36.5	422.5	323.5
Sodium (mg Na/L)	10.1	6.6	3.5	56.7	27.3	43.0	2.9	63.5	47.5
Calcium (mg Ca/L)	2.5	2.6	2.8	8.8	4.2	7.2	1.0	9.9	8.9
Magnesium (mg Mg/L)	0.7	0.7	0.5	1.2	1.1	1.2	0.5	1.9	1.3
Potassium (mg K/L)	0.5	0.5	0.3	1.0	0.7	1.2	0.4	1.4	1.1
Chloride (mg Cl/L)	16.7	9.9	5.7	92.0	42.6	67.9	4.6	103.0	76.2
Sulphate (mg SO_4/L)	2.1	2.3	2.2	4.9	4.3	4.5	1.8	4.9	4.8
Gran alkalinity (mg $CaCO_3$/L)	0.60	1.20	2.40	5.10	0.00	4.80	0.00	9.90	7.70
Ammonia (mg N/L)	0.013	0.020	0.005	0.010	0.007	0.007	0.008	0.012	0.007
Nitrate (mg N/L)	0.15	0.12	0.04	0.19	0.07	0.18	0.06	0.11	0.18
Phosphate (mg P/L)	0.003	0.003	0.002	0.003	0.002	0.002	0.001	0.003	0.002
Silicate (mg Si/L)	0.03	0.02	0.13	0.12	0.04	0.22	0.03	0.29	0.29
Total Nitrogen (mg N/L)	0.27	0.31	0.14	0.35	0.22	0.30	0.17	0.30	0.30
Total Phosphorus (mg P/L)	0.016	0.014	0.014	0.006	0.020	0.011	0.016	0.007	0.012
Chlorophyll a (mg/L)	0.78	2.13	1.21	1.08	1.59	0.82	0.36	1.84	1.41
Colour (TCU)	20.0	19.2	12.5	5.0	53.3	8.8	16.5	10.0	10.0
DOC (mg C/L)	3.3	3.1	2.3	1.7	3.8	1.7	3.3	1.5	1.9

Table 7-4. Data for individual lake samples collected in 1991, averages only.

	Miller	*Morris*	*Oathill*	*Paper Mill*	*Parr*	*Penhorn*	*Powder Mill*	*Power Pond*	*Rocky*
Temperature (°C)	7.5	7.5	7.0	5.6	6.9	6.0	6.9		7.5
pH	5.12	6.51	6.80	5.75	5.40	7.05	6.74		6.90
Conductivity (µS)	109.4	309.0	580.0	78.9	74.6	614.0	149.0		205.5
Theoretical Conductivity (µS)	108.3	320.8	637.8	79.3	76.4	693.3	152.8		213.1
Sodium (mg Na/L)	14.7	46.4	89.9	10.3	8.0	108.0	17.8		26.0
Calcium (mg Ca/L)	3.1	9.1	18.9	2.5	3.8	16.8	7.9		11.2
Magnesium (mg Mg/L)	0.7	1.4	2.9	0.7	0.8	1.8	1.1		1.3
Potassium (mg K/L)	0.5	1.4	2.5	0.5	0.9	1.5	1.2		1.7
Chloride (mg Cl/L)	23.7	74.9	152.0	17.0	12.3	171.0	28.7		40.9
Sulphate (mg SO_4/L)	2.7	5.0	8.2	2.1	3.6	6.1	3.7		4.4
Gran alkalinity (mg $CaCO_3$/L)	0.10	8.30	21.00	0.60	0.70	18.20	11.00		14.70
Ammonia (mg N/L)	0.018	0.009	0.010	0.007	0.002	0.004	0.002		0.006
Nitrate (mg N/L)	0.12	0.45	0.63	0.14	0.01	0.10	0.28		0.44
Phosphate (mg P/L)	0.002	0.004	0.007	0.002	0.004	0.003	0.003		0.003
Silicate (mg Si/L)	0.04	0.23	0.05	0.02	0.05	0.15	0.32		0.21
Total Nitrogen (mg N/L)	0.31	0.98	0.91	0.27	0.22	0.29	0.42		0.46
Total Phosphorus (mg P/L)	0.007	0.008	0.005	0.016	0.011	0.002	0.010		0.008
Chlorophyll a (mg/L)	2.12	6.04	16.11	0.49	6.28	2.53	3.37		1.39
Colour (TCU)	18.8	12.5	15.8	20.0	55.0	10.0	12.5	30.0	12.5
DOC (mg C/L)	3.3	2.3	3.0	3.2	6.3	1.8	1.9	3.8	2.4

Table 7-5. Data for individual lake samples collected in 1991, averages only.

	Russell	*Sandy*	*Second*	*Second Chain*	*Settle*	*Soldier*	*Spider*	*Spruce Hill*	*Susie*
Temperature (°C)	7.8	6.0	6.5	7.0	5.0	6.7	8.3	6.7	6.9
pH	6.52	5.29	6.03	4.40	6.70	4.79	4.90	4.66	4.77
Conductivity (µS)	431.7	113.7	76.1	478.0	514.0	86.4	30.1	33.7	56.3
Theoretical Conductivity (µS)	463.4	116.0	77.4	524.8	560.1	85.2	29.7	33.8	55.4
Sodium (mg Na/L)	70.0	15.3	9.0	70.5	82.7	10.1	2.2	2.9	6.4
Calcium (mg Ca/L)	11.2	3.3	3.3	9.5	14.0	2.6	1.0	0.5	1.4
Magnesium (mg Mg/L)	1.5	0.9	0.8	2.8	2.0	0.6	0.5	0.4	0.5
Potassium (mg K/L)	1.4	0.7	0.7	1.2	2.0	0.5	0.3	0.3	0.4
Chloride (mg Cl/L)	112.6	25.0	15.5	115.0	136.0	16.7	3.4	5.0	10.5
Sulphate (mg SO_4/L)	5.9	3.3	2.4	16.7	6.8	2.7	1.8	1.2	1.5
Gran alkalinity (mg $CaCO_3$/L)	9.53	0.10	1.15	0.00	15.80	0.00	0.00	0.00	0.00
Ammonia (mg N/L)	0.006	0.023	0.002	0.005	0.011	0.079	0.012	0.022	0.004
Nitrate (mg N/L)	0.15	0.08	0.02	0.11	0.21	0.13	0.01	0.05	0.04
Phosphate (mg P/L)	0.006	0.002	0.003	0.002	0.008	0.003	0.002	0.002	0.002
Silicate (mg Si/L)	0.20	0.02	0.04	0.11	0.06	0.05	0.04	0.04	0.02
Total Nitrogen (mg N/L)	0.45	0.25	0.18	0.20	0.42	0.41	0.14	0.21	0.16
Total Phosphorus (mg P/L)	0.010	0.019	0.009	0.027	0.004	0.013	0.012	0.009	0.013
Chlorophyll a (mg/L)	6.64	0.93	2.41	0.68	12.08	1.14	0.62	1.01	1.00
Colour (TCU)	11.7	22.5	16.3	5.0	20.0	25.0	20.0	35.0	27.5
DOC (mg C/L)	2.3	3.0	3.1	1.0	2.9	3.8	3.2	3.9	4.0

Table 7-6. Data for individual lake samples collected in 1991, averages only.

	Third	*Thomas*	*Topsail*	*Whimsical*	*William*	*Williams*
Temperature (°C)	6.2	7.5	6.0	8.4	7.2	7.1
pH	6.18	6.35	6.33	6.90	6.48	6.37
Conductivity (µS)	84.9	133.9	39.7	763.0	132.0	176.0
Theoretical Conductivity (µS)	85.0	132.6	40.1	834.0	131.9	187.7
Sodium (mg Na/L)	9.5	17.1	3.4	114.0	16.5	28.3
Calcium (mg Ca/L)	4.0	5.0	2.8	24.5	5.5	4.8
Magnesium (mg Mg/L)	0.8	0.8	0.5	2.9	0.9	1.0
Potassium (mg K/L)	0.8	0.8	0.3	2.7	0.9	0.9
Chloride (mg Cl/L)	16.0	28.1	5.5	197.0	26.7	41.2
Sulphate (mg SO_4/L)	2.6	3.1	1.9	17.3	3.2	4.2
Gran alkalinity (mg $CaCO_3$/L)	3.75	4.90	2.70	11.30	6.23	2.00
Ammonia (mg N/L)	0.001	0.007	0.008	0.014	0.011	0.009
Nitrate (mg N/L)	0.04	0.14	0.04	0.48	0.15	0.17
Phosphate (mg P/L)	0.003	0.002	0.002	0.003	0.002	0.002
Silicate (mg Si/L)	0.07	0.12	0.11	0.13	0.20	0.03
Total Nitrogen (mg N/L)	0.21	0.28	0.17	0.64	0.30	0.30
Total Phosphorus (mg P/L)	0.010	0.012	0.014	0.016	0.012	0.012
Chlorophyll a (mg/L)	3.79	1.60	0.88	1.17	1.33	0.73
Colour (TCU)	10.0	17.5	12.5	7.5	15.8	15.0
DOC (mg C/L)	2.9	2.9	2.4	2.0	3.0	2.9

APPENDIX C - Data Collected in 2000

An electronic copy of these data can be obtained from the Halifax Regional Municipality at XXXX

Table 8. Data for individual lake samples collected in 2000, numbers in brackets refer to locations in Figure 1.

	Anderson (68)	*Big Albro (79)*	*Banook (69)*	*Banook (70)*	*Banook (70)*	*Banook (70)*	*Bayers (25)*	*Bell (82)*	*Bell (82)*
Temperature (°C)	5.2	8.5	7	7.5	7.5	7.5	9.3	7.5	6.3
pH	5.74	6.93	7.19	6.87	7.11	6.93	5.36	6.56	6.36
pH (EC)	5.55	7.09	7.48	7.45	7.54	7.6	5.21	5.76	5.9
Theoretical Conductivity (µS)	59.2	357.4	395.7	391.6	399.3	397.9	445.5	54.9	53.5
Na (mg/L)	7.2	56.2	58.7	59.1	59.5	59.1	61.5	5.14	5.02
Ca (mg/L)	2	8.7	13.3	13.8	13.6	13.5	12.2	2.4	2.4
Mg (mg/L)	0.61	1.17	1.74	1.72	1.75	1.74	2.7	1.03	1.03
K (mg/L)	0.39	0.82	1.2	1.16	1.13	1.13	1.44	0.63	0.59
Al (mg/L)	0.123	0.016	0.025	0.023	0.026	0.026	0.195	0.066	0.054
Cl (mg/L)	12.1	89.2	93.1	90.5	93.8	93.6	106	9.35	9.11
SO4l (mg SO_4/L)	5.7	11.8	18.2	17.8	18	18.1	26.5	7.78	7.57
Gran alkalinity (mg $CaCO_3$/L)	-0.24	8.16	15	15	15.9	17.2	-0.57	-0.2	-0.2
Ammonia (mg N/L)	0.007	0.008	0.008	0.008	0.007	0.008	0.035	0.013	0.008
Nitrate (mg N/L)	0.01	0.08	0.31	0.31	0.31	0.31	0.09	0.39	0.08
Phosphate (mg P/L)	0.001	0.004	0.002	0.008	0.003	0.006	0.002	0.008	0.004
Silicate (mg Si/L)	0.01	0.46	0.36	0.42	0.70	0.56	0.03	0.35	0.02
Total Nitrogen (mg N/L)	0.05	0.12	0.33	0.34	0.31	0.29	0.16	0.12	0.1
Total Phosphorus (mg P/L)	0.008	0.008	0.007	0.014	0.007	0.007	0.014	0.008	0.006
Chlorophyll a (mg/L)	4.56	3.88	2.20	2.08	1.91	2.04	1.21	2.32	3.16
Theoretical Colour (TCU)	12	6	4	5	4	4	4	6	4
DOC (mg C/L)	3.6	4.1	2.4	2.4	4.2	4.3	2.5	1.7	1.6

Table 8-2. Data for individual lake samples collected in 2000, numbers in brackets refer to locations in Figure 1.

	Bissett (60)	*Bissett (61)*	*Charles (56)*	*Charles (57)*	*Chocolate (83)*	*Colbart (32)*	*Cranberry (80)*	*F.Chain (27)*	*First (71)*
Temperature (°C)	6.1	5.9	5.6	4.6	5	6.4	3.5	5.7	4.9
pH	6.41	6.59	6.55	6.26	6.69	5.9	6.98	4.86	6.67
pH (EC)	7.39	7.44	7.25	7.12	6.66	4.49	7.51	4.78	7.47
Theoretical Conductivity (µS)	603.7	591.5	230.9	231.6	503.6	96.6	569.2	329.0	480.3
Na (mg/L)	91.6	90.5	32.2	32.3	76.7	10.61	85.7	48.1	69.7
Ca (mg/L)	17.4	17.7	8.6	8.8	11.6	3.2	15.7	5.5	16.8
Mg (mg/L)	2.4	2.4	1.49	1.46	1.69	0.83	2.21	1.39	2.03
K (mg/L)	1.89	1.92	1.07	1.09	0.97	0.61	1.73	0.62	1.56
Al (mg/L)	0.041	0.044	0.030	0.037	0.098	0.210	0.022	0.751	0.027
Cl (mg/L)	152	147	52.6	52.6	122	16.7	144	80.3	117
SO4l (mg SO_4/L)	16.5	16.5	12.8	12.8	26.4	9.31	16.9	18.3	17.6
Gran alkalinity (mg $CaCO_3$/L)	23.7	23.6	9.58	9.85	1.45	-1.71	19.8	-1.07	22.4
Ammonia (mg N/L)	0.010	0.010	0.013	0.014	0.021	0.010	0.008	0.007	0.009
Nitrate (mg N/L)	0.33	0.34	0.42	0.42	0.23	0.04	0.50	0.03	0.21
Phosphate (mg P/L)	0.007	0.007	0.004	0.004	0.001	0.002	0.005	0.000	0.002
Silicate (mg Si/L)	0.01	0.02	0.16	0.22	0.14	0.03	0.27	0.05	0.25
Total Nitrogen (mg N/L)	0.43	0.47	0.42	0.34	0.27	0.09	0.61	0.05	0.21
Total Phosphorus (mg P/L)	0.022	0.021	0.01	0.01	0.002	0.014	0.013	0.002	0.008
Chlorophyll a (mg/L)	11.36	11.99	1.14	1.04	0.11	4.68	3.76	0.40	3.32
Theoretical Colour (TCU)	8	7	5	4	4	40	9	4	4
DOC (mg C/L)	7.1	6.4	2.5	2.6	0.4	7.7	5	0.9	2.3

Table 8-3. Data for individual lake samples collected in 2000, numbers in brackets refer to locations in Figure 1.

	First (72)	*Fletcher (35)*	*Fletcher (36)*	*Fletcher (37)*	*Fraser (23)*	*Fraser (24)*	*Frenchman (67)*	*Frog Pond (85)*	*Governor (21)*
Temperature (°C)	5.1	5.7	5.3	5.3	4.8	5.5	9.9	6	5
pH	6.61	6.41	6.43	6.56	4.88	4.95	6.16	6.44	5.76
pH (EC)	7.54	6.84	6.9	6.88	5.06	5.11	6.06	7.38	6.21
Theoretical Conductivity (µS)	477.5	154.7	155.4	152.4	63.6	62.3	481.3	530.5	415.2
Na (mg/L)	72.1	21.7	21.8	21.2	7.56	7.48	74.5	78.4	61.8
Ca (mg/L)	16.4	5.8	5.9	6	2.1	2.1	8.6	17	10.4
Mg (mg/L)	2.1	0.98	0.97	0.97	0.69	0.68	1.46	1.76	1.89
K (mg/L)	1.61	0.81	0.82	0.79	0.55	0.55	0.73	1.49	1.21
Al (mg/L)	0.028	0.101	0.092	0.085	0.247	0.235	0.107	0.056	0.281
Cl (mg/L)	114	34.4	34.6	33.7	12.9	12.5	126	129	104
SO4l (mg SO_4/L)	17.1	9.41	9.3	9.29	5.01	5.07	15.2	21.9	15.8
Gran alkalinity (mg $CaCO_3$/L)	21.9	5.46	3.71	3.62	-0.6	-0.47	0.64	17	0.95
Ammonia (mg N/L)	0.009	0.017	0.023	0.026	0.016	0.014	0.014	0.029	0.028
Nitrate (mg N/L)	0.20	0.19	0.20	0.19	0.05	0.05	0.05	0.26	0.62
Phosphate (mg P/L)	0.002	0.002	0.002	0.006	0.003	0.005	0.004	0.004	0.002
Silicate (mg Si/L)	0.23	0.09	0.10	0.16	0.02	0.04	0.03	0.59	0.05
Total Nitrogen (mg N/L)	0.23	0.25	0.24	0.19	0.07	0.06	0.09	0.32	0.68
Total Phosphorus (mg P/L)	0.01	0.009	0.01	0.012	0.012	0.012	0.012	0.02	0.013
Chlorophyll a (mg/L)	3.28	1.50	1.43	1.17	1.16	1.12	4.48	0.56	1.28
Theoretical Colour (TCU)	4	14	17	16	26	19	29	17	19
DOC (mg C/L)	6.3	3.7	3.6	4.2	7	6.3	5.9	3.2	4.6

Table 8-4. Data for individual lake samples collected in 2000, numbers in brackets refer to locations in Figure 1.

	Governor (22)	*Governor (22)*	*Grand (1)*	*Grand (2)*	*Grand (3)*	*Kearny (17)*	*Kearny (18)*	*Kinsac (4)*	*Kinsac (5)*
Temperature (°C)	5.4	6.1	3.5	2.8	3.2	4.6	5.6	4.8	4.3
pH	5.91	6.14	6.1	6.39	6.26	6.43	6.92	6	6.45
pH (EC)	6.28	6.17	6.65	6.64	6.74	6.49	6.53	5.95	6.46
Theoretical Conductivity (µS)	411.7	407.7	94.0	95.0	96.2	144.2	159.6	50.7	71.9
Na (mg/L)	60	59.4	10.8	11.7	12.1	20.4	22.4	5.53	8.5
Ca (mg/L)	10.6	10.2	4.7	4.9	4.7	4.7	5.2	2.3	3.5
Mg (mg/L)	1.77	1.84	0.82	0.77	0.78	0.99	1.04	0.64	0.79
K (mg/L)	1.22	1.19	0.55	0.52	0.52	0.58	0.58	0.36	0.51
Al (mg/L)	0.272	0.310	0.062	0.066	0.067	0.206	0.205	0.129	0.127
Cl (mg/L)	104	103.2	18.6	18.4	18.9	33.8	38.2	9.97	14.6
SO4l (mg SO_4/L)	16	15.8	9.58	9.08	8.93	7.31	7.45	5.26	6.08
Gran alkalinity (mg $CaCO_3$/L)	0.26	1.06	1.58	1.56	2.95	2.9	2.29	0.34	0.96
Ammonia (mg N/L)	0.026	0.028	0.015	0.015	0.017	0.023	0.022	0.009	0.014
Nitrate (mg N/L)	0.62	0.69	0.08	0.09	0.09	0.28	0.31	0.06	0.11
Phosphate (mg P/L)	0.002	0.005	0.001	0.006	0.004	0.004	0.004	0.002	0.003
Silicate (mg Si/L)	0.05	0.05	0.07	0.08	0.09	0.07	0.07	0.04	0.06
Total Nitrogen (mg N/L)	0.64	0.66	0.12	0.11	0.12	0.31	0.33	0.08	0.13
Total Phosphorus (mg P/L)	0.013	0.017	0.01	0.017	0.006	0.011	0.006	0.011	0.01
Chlorophyll a (mg/L)	1.03	1.09	2.00	2.16	2.20	0.40	0.56	2.24	0.91
Theoretical Colour (TCU)	30	20	12	12	8	18	17	11	23
DOC (mg C/L)	4.9	4.8	3.6	3.9	3.7	3.9	4.2	4.6	4.7

Table 8-5. Data for individual lake samples collected in 2000, numbers in brackets refer to locations in Figure 1.

	Kinsac (6)	*L. Albro (78)*	*Lamont (73)*	*Long (28)*	*Long (29)*	*Long (30)*	*Loon (54)*	*Loon (55)*	*Major (50)*
Temperature (°C)	4.7	9	6.8	4.5	4.5	4.8	6.8	6.5	3.5
pH	6.53	6.96	6.2	5.52	5.41	5.34	6.23	6.82	4.71
pH (EC)	6.56	7.12	5.35	5.26	5.29	5.29	7.2	7.2	4.71
Theoretical Conductivity (µS)	79.6	332.4	59.3	223.3	217.0	214.4	311.6	307.7	37.6
Na (mg/L)	9.6	51.9	5.79	33.1	32	31.7	45.7	46.6	3.61
Ca (mg/L)	3.9	8.6	2.9	5	5	5	8.8	8.6	1
Mg (mg/L)	0.83	1.09	0.67	1.2	1.14	1.15	1.43	1.45	0.46
K (mg/L)	0.54	0.81	0.33	0.69	0.69	0.66	1.08	1.18	0.24
Al (mg/L)	0.140	0.019	0.125	0.234	0.237	0.244	0.037	0.033	0.204
Cl (mg/L)	16.4	81.3	10.1	54.2	52.6	51.7	77.3	74.7	5.33
SO4l (mg SO_4/L)	6.25	12.9	8.47	10.4	10.3	10.3	12	12	4.46
Gran alkalinity (mg $CaCO_3$/L)	1.58	9.32	-0.44	-0.2	-0.44	-0.41	9.93	9.4	-1.11
Ammonia (mg N/L)	0.013	0.013	0.009	0.023	0.024	0.022	0.013	0.012	0.014
Nitrate (mg N/L)	0.12	0.12	0.03	0.08	0.08	0.08	0.20	0.20	0.05
Phosphate (mg P/L)	0.002	0.001	0.002	0.000	0.001	0.000	0.003	0.005	0.003
Silicate (mg Si/L)	0.10	0.20	0.02	0.03	0.03	0.03	0.13	0.15	0.03
Total Nitrogen (mg N/L)	0.17	0.14	0.04	0.16	0.15	0.14	0.24	0.25	0.1
Total Phosphorus (mg P/L)	0.012	0.008	0.006	0.011	0.007	0.007	0.012	0.006	0.004
Chlorophyll a (mg/L)	1.16	0.69	0.71	0.45	0.40	0.49	0.73	0.80	0.40
Theoretical Colour (TCU)	24	4	7	33	39	45	4	4	15
DOC (mg C/L)	4.7	3.6	1.7	6.2	6.2	6.6	3.8	2.3	4.6

Table 8-6. Data for individual lake samples collected in 2000, numbers in brackets refer to locations in Figure 1.

	Major (50)	*Major (50)*	*Major (51)*	*Major (52)*	*Major (53)*	*Maynard (77)*	*Maynard (77)*	*Maynard (77)*	*Micmac (58)*
Temperature (°C)	3.4	3.5	3.4	3.5	4	7.5	7.5	7.5	6.9
pH	4.73	4.89	4.76	4.85	4.88	7.09	7.04	7.16	6.26
pH (EC)	4.7	4.72	4.72	4.74	4.73	7.53	7.42	7.39	7.25
Theoretical Conductivity (µS)	38.0	37.7	37.8	38.1	38.1	385.2	382.8	384.8	352.0
Na (mg/L)	3.67	3.65	3.66	3.77	3.75	58.7	57.7	58.7	49.7
Ca (mg/L)	0.97	0.98	0.98	0.98	1	11	11	10.8	12.2
Mg (mg/L)	0.47	0.47	0.46	0.47	0.46	1.89	1.87	1.85	1.58
K (mg/L)	0.25	0.25	0.25	0.25	0.25	1.2	1.2	1.27	0.99
Al (mg/L)	0.208	0.210	0.204	0.208	0.209	0.020	0.018	0.020	0.034
Cl (mg/L)	5.39	5.42	5.45	5.62	5.54	94.1	94	94.1	84.5
SO4l (mg SO_4/L)	4.45	4.47	4.47	4.49	4.48	13.5	13.5	13.6	16.7
Gran alkalinity (mg $CaCO_3$/L)	-1.27	-1.27	-1.21	-1.1	-1.11	14.9	13.6	13.8	12.1
Ammonia (mg N/L)	0.015	0.014	0.014	0.014	0.013	0.028	0.027	0.027	0.010
Nitrate (mg N/L)	0.05	0.05	0.05	0.05	0.05	0.21	0.20	0.21	0.29
Phosphate (mg P/L)	0.000	0.001	0.000	0.001	0.001	0.002	0.005	0.003	0.004
Silicate (mg Si/L)	0.02	0.02	0.01	0.02	0.01	0.39	0.24	0.32	0.18
Total Nitrogen (mg N/L)	0.1	0.1	0.1	0.11	0.11	0.24	0.24	0.23	0.28
Total Phosphorus (mg P/L)	0.008	0.004	0.011	0.006	0.004	0.01	0.017	0.009	0.01
Chlorophyll a (mg/L)	0.56	0.41	0.37	0.41	0.43	0.73	0.73	0.75	1.64
Theoretical Colour (TCU)	14	16	16	13	14	4	4	6	6
DOC (mg C/L)	4.3	3.7	3.8	4.6	4.3	4.5	4.3	4.4	2.4

Table 8-7. Data for individual lake samples collected in 2000, numbers in brackets refer to locations in Figure 1.

	Micmac (59)	*Miller (46)*	*Miller (47)*	*Morris (62)*	*Morris (62)*	*Morris (63)*	*Morris (64)*	*Morris (64)*	*Oathill (75)*
Temperature (°C)	6.7	5.6	5	6.2	6.9	5.9	6.5	6.6	7.5
pH	6.58	6.14	6.36	6.1	6.53	5.8	6.39	6.61	7.32
pH (EC)	7.21	5.69	5.63	7.17	7.11	7.23	7.22	7.21	7.53
Theoretical Conductivity (µS)	359.8	95.7	103.0	296.4	292.5	312.9	319.5	319.3	523.8
Na (mg/L)	51.6	13.14	14.2	43.7	43	46	47.7	46	76.4
Ca (mg/L)	12.4	3.3	3.5	9.1	9.5	9.7	9.7	9.9	19.2
Mg (mg/L)	1.57	0.68	0.72	1.37	1.42	1.44	1.45	1.43	2.9
K (mg/L)	1.02	0.46	0.47	1.02	1	1.06	1.06	1.04	2.03
Al (mg/L)	0.026	0.170	0.137	0.038	0.039	0.051	0.043	0.037	0.024
Cl (mg/L)	86	20.4	22.5	71.4	69.7	75.5	76.9	78.3	124
SO4l (mg SO_4/L)	16.7	7.38	7.17	12.8	12.8	13.4	13.4	13.4	20.1
Gran alkalinity (mg $CaCO_3$/L)	12.5	-0.29	-0.07	9.03	10.2	8.96	8.85	10.3	25
Ammonia (mg N/L)	0.011	0.084	0.055	0.008	0.010	0.008	0.008	0.009	0.020
Nitrate (mg N/L)	0.29	0.21	0.20	0.22	0.22	0.22	0.22	0.21	0.69
Phosphate (mg P/L)	0.004	0.003	0.003	0.003	0.005	0.002	0.002	0.006	0.005
Silicate (mg Si/L)	0.21	0.03	0.03	0.12	0.10	0.11	0.12	0.12	0.65
Total Nitrogen (mg N/L)	0.35	0.32	0.24	0.24	0.21	0.27	0.25	0.23	0.73
Total Phosphorus (mg P/L)	0.007	0.012	0.012	0.011	0.014	0.014	0.018	0.016	0.015
Chlorophyll a (mg/L)	1.01	3.92	3.28	3.00	3.04	3.56	3.54	4.84	2.32
Theoretical Colour (TCU)	6	24	14	6	6	6	7	5	6
DOC (mg C/L)	2.3	4.9	5.3	3.3	2.8	3.6	2.9	4.3	4.5

Table 8-8. Data for individual lake samples collected in 2000, numbers in brackets refer to locations in Figure 1.

	Paper Mill (16)	*Parr (33)*	*Penhorn (76)*	*Powder Mill (11)*	*Power Pond (86)*	*Rocky (12)*	*Rocky (13)*	*Russell (65)*	*Russell (66)*
Temperature (°C)	6.6	7.5	7	5.7	5.5	6.8	7	6.4	6.4
pH	6.36	4.66	7.34	6.59	5.59	6.57	6.59	6.68	6.59
pH (EC)	6.63	4.62	7.48	7.16	5.87	7.46	7.38	7.24	7.24
Theoretical Conductivity (µS)	152.4	36.9	551.7	201.6	169.2	257.3	324.2	534.1	531.0
Na (mg/L)	21.2	3.54	85.4	26.5	25.6	32.4	44.1	79.9	81.1
Ca (mg/L)	5	0.54	16.7	10.5	4	15	15.2	13.3	12.6
Mg (mg/L)	0.99	0.46	1.78	1.32	1.04	1.51	1.62	1.69	1.72
K (mg/L)	0.6	0.22	0.99	1.56	0.62	2.14	1.77	1.14	1.18
Al (mg/L)	0.177	0.286	0.021	0.024	0.247	0.023	0.026	0.045	0.051
Cl (mg/L)	36.4	5.93	139	43.3	39.7	54.2	73.7	138	136
SO4l (mg SO_4/L)	7.42	3.03	13.2	11.2	8.91	15.3	15.3	16.5	16.7
Gran alkalinity (mg $CaCO_3$/L)	2.13	-1.68	21.3	14	0.52	21.9	18.5	12.1	11.9
Ammonia (mg N/L)	0.021	0.012	0.021	0.009	0.007	0.014	0.025	0.011	0.010
Nitrate (mg N/L)	0.27	0.06	0.12	0.25	0.08	0.40	0.36	0.01	0.01
Phosphate (mg P/L)	0.004	0.002	0.003	0.001	0.003	0.002	0.003	0.007	0.007
Silicate (mg Si/L)	0.07	0.02	0.43	0.63	0.03	0.54	0.36	0.11	0.11
Total Nitrogen (mg N/L)	0.3	0.12	0.17	0.24	0.1	0.38	0.36	0.05	0.06
Total Phosphorus (mg P/L)	0.011	0.01	0.008	0.008	0.01	0.01	0.007	0.022	0.021
Chlorophyll a (mg/L)	0.35	1.67	0.52	1.80	1.38	1.40	1.36	8.21	7.95
Theoretical Colour (TCU)	16	39	4	4	30	9	9	8	4
DOC (mg C/L)	3.7	5.1	5.5	3.1	6.4	3.1	2.7	5.3	3.3

Table 8-9. Data for individual lake samples collected in 2000, numbers in brackets refer to locations in Figure 1.

	S. Chain (26)	*Sandy (14)*	*Sandy (15)*	*Second (9)*	*Second (10)*	*Settle (81)*	*Soldier (43)*	*Soldier (44)*	*Soldier (45)*
Temperature (°C)	6.1	5.1	5.7	6.3	5.2	6.5	4.4	4	4.1
pH	4.87	5.81	5.65	6.63	6.55	7.1	5.58	5.83	5.54
pH (EC)	4.79	5.91	5.68	6.82	6.95	7.41	5.22	5.36	5.01
Theoretical Conductivity (µS)	374.1	132.1	133.0	133.4	151.2	490.9	90.7	90.5	90.9
Na (mg/L)	53.5	17.7	18.4	18	21.1	75.5	11.41	11.2	10.8
Ca (mg/L)	7.6	4	3.9	5.1	5.9	14.9	3.2	3.1	3
Mg (mg/L)	1.61	0.99	0.97	1	1.09	2.2	0.68	0.68	0.68
K (mg/L)	0.67	0.66	0.67	0.73	0.82	1.75	0.45	0.53	0.45
Al (mg/L)	0.919	0.191	0.183	0.051	0.063	0.053	0.177	0.195	0.199
Cl (mg/L)	91.7	30.2	30	31.2	34.8	120	19.2	19.4	19.4
SO4l (mg SO_4/L)	20.2	9.07	8.97	6.37	6.94	14.9	7.41	7.76	7.65
Gran alkalinity (mg $CaCO_3$/L)	-0.78	0.21	0.42	5.7	6.58	21.4	-0.32	-0.91	-0.47
Ammonia (mg N/L)	0.010	0.021	0.019	0.009	0.009	0.041	0.118	0.140	0.134
Nitrate (mg N/L)	0.04	0.10	0.10	0.03	0.06	0.32	0.21	0.22	0.22
Phosphate (mg P/L)	0.000	0.001	0.004	0.003	0.002	0.005	0.002	0.002	0.002
Silicate (mg Si/L)	0.07	0.03	0.04	0.10	0.15	0.71	0.03	0.02	0.03
Total Nitrogen (mg N/L)	0.06	0.17	0.14	0.06	0.09	0.34	0.31	0.31	0.23
Total Phosphorus (mg P/L)	0.004	0.008	0.008	0.01	0.008	0.022	0.012	0.02	0.014
Chlorophyll a (mg/L)	0.22	0.66	0.85	2.17	1.64	2.16	4.64	4.64	4.92
Theoretical Colour (TCU)	4	8	12	10	7	16	24	29	20
DOC (mg C/L)	1	5.1	4.3	4.2	4.5	3.7	5.1	5.2	5.1

Table 8-10. Data for individual lake samples collected in 2000, numbers in brackets refer to locations in Figure 1.

	Spider (48)	*Spider (49)*	*Spruce Hill (34)*	*Susie (19)*	*Susie (19)*	*Susie (20)*	*Third (7)*	*Third (8)*	*Thomas (38)*
Temperature (°C)	6	5.7	5.7	5.9	6.5	5.8	4.6	4.7	5.2
pH	5.02	4.84	4.89	4.82	5.4	4.68	6.58	6.25	6.81
pH (EC)	4.88	4.69	4.64	4.85	4.88	4.78	7.01	6.98	6.89
Theoretical Conductivity (µS)	33.1	35.2	36.3	133.1	129.9	138.0	130.1	128.0	147.6
Na (mg/L)	3.01	3.02	3.48	18.7	17.7	19.5	17.3	16.7	20.8
Ca (mg/L)	1.1	1	0.48	3	3	2.9	5.8	5.9	5.6
Mg (mg/L)	0.53	0.53	0.47	0.7	0.71	0.69	1.06	1.04	0.94
K (mg/L)	0.18	0.2	0.2	0.36	0.34	0.37	0.84	0.77	0.78
Al (mg/L)	0.167	0.198	0.286	0.230	0.230	0.228	0.035	0.033	0.076
Cl (mg/L)	4.61	4.72	6	32	31.7	33.3	28.7	28.2	32.8
SO4l (mg SO_4/L)	4.51	4.23	3.01	5.66	5.56	5.56	7.22	7.32	8.76
Gran alkalinity (mg $CaCO_3$/L)	-0.93	-1.36	-1.07	-1.02	-0.99	-1.23	5.34	7.3	3.82
Ammonia (mg N/L)	0.012	0.014	0.014	0.013	0.016	0.012	0.008	0.009	0.025
Nitrate (mg N/L)	0.03	0.03	0.07	0.08	0.08	0.06	0.09	0.09	0.19
Phosphate (mg P/L)	0.000	0.000	0.002	0.003	0.003	0.004	0.002	0.001	0.002
Silicate (mg Si/L)	0.01	0.01	0.03	0.03	0.04	0.03	0.13	0.13	0.15
Total Nitrogen (mg N/L)	0.08	0.09	0.09	0.14	0.12	0.08	0.1	0.12	0.22
Total Phosphorus (mg P/L)	0.007	0.011	0.006	0.013	0.005	0.006	0.008	0.008	0.008
Chlorophyll a (mg/L)	1.01	1.02	1.74	1.20	1.30	1.28	2.56	2.60	1.47
Theoretical Colour (TCU)	9	32	31	19	21	13	7	5	17
DOC (mg C/L)	3.5	5.3	5.3	4.8	5.1	5	3.3	3.2	3.6

Table 8-11. Data for individual lake samples collected in 2000, numbers in brackets refer to locations in Figure 1.

	Thomas (39)	*Topsail (74)*	*Whimsical (84)*	*William (40)*	*William (41)*	*William (42)*	*Williams (31)*
Temperature (°C)	4.8	6.2	6	3.8	4	4.5	5.6
pH	6.53	5.88	7.02	6.64	6.34	6.07	5.88
pH (EC)	7.08	5.54	7.5	7.21	7.17	7.14	6.43
Theoretical Conductivity (µS)	169.9	63.8	648.2	167.5	167.9	164.9	184.0
Na (mg/L)	23.7	6.64	95.2	22.9	23.8	23	27.4
Ca (mg/L)	7.1	3.1	19.8	6.7	6.8	6.6	5
Mg (mg/L)	0.99	0.65	2.1	1.08	1.09	1.07	0.95
K (mg/L)	0.98	0.34	1.55	0.99	1.02	0.98	0.72
Al (mg/L)	0.043	0.089	0.101	0.044	0.044	0.046	0.158
Cl (mg/L)	37.8	11.3	160	37.7	36.8	36.5	42.2
SO4l (mg SO_4/L)	9.37	8.64	26.4	9.54	9.52	9.53	11.2
Gran alkalinity (mg $CaCO_3$/L)	6.87	-0.48	19.4	8.39	8.47	7.96	1.04
Ammonia (mg N/L)	0.016	0.011	0.017	0.015	0.014	0.014	0.009
Nitrate (mg N/L)	0.17	0.03	0.36	0.17	0.17	0.17	0.14
Phosphate (mg P/L)	0.002	0.004	0.005	0.003	0.001	0.001	0.001
Silicate (mg Si/L)	0.20	0.02	0.32	0.14	0.13	0.21	0.04
Total Nitrogen (mg N/L)	0.18	0.05	0.41	0.21	0.25	0.21	0.24
Total Phosphorus (mg P/L)	0.009	0.003	0.009	0.008	0.008	0.006	0.008
Chlorophyll a (mg/L)	1.01	0.37	1.53	0.85	1.12	0.83	1.35
Theoretical Colour (TCU)	12	4	5	4	13	18	20
DOC (mg C/L)	3.3	1.8	2.6	3.6	3.6	5.6	3.6

APPENDIX D - Elemental Data Collected in 1991

Table 9. Concentration (ppb or µg/L) of various elements in samples from 1991, numbers in brackets refer to locations in Figure 1.

Element	*Anderson (68)*	*Big Albro (79)*	*Banook (70)*	*Banook (70)*	*Banook (69)*	*Banook (70)*	*Bayers (25)*	*Bell (82)*	*Bissett (60)*	*Bissett (61)*	*Charles (56)*
As	0.1	0.3	2.1	2.2	2.3	2	0.600	0.3	0.2	0.2	6.4
Cd	0.12	0.04	0.08	0.09	0.06	0.07	0.630	0.05	0.18	0.55	0.34
Ce	0.57	0.12	0.29	0.39	0.32	0.34	5.970	0.43	0.07	0.15	0.78
Cu	0.7	1.2	1.9	2.4	1.9	2	5.500	0.7	3.8	4.1	2.4
Dy	0.04	0.011	0.025	0.032	0.029	0.031	0.653	0.027	0.01	0.02	0.05
Er	0.024	0.007	0.015	0.022	0.015	0.017	0.390	. 0.017	0.006	0.013	0.023
Eu	0.014	0.004	0.012	0.013	0.012	0.013	0.157	0.01	0.004	0.007	0.021
Fe	267	84	56	158	81	84	762.000	295	101	111	389
Gd	0.062	0.02	0.049	0.087	0.052	0.087	0.658	0.063	0.015	0.036	0.095
Ho	0.009	0.002	0.006	0.007	0.006	0.007	0.140	0.005	0.002	0.005	0.009
In	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001
La	0.68	0.13	0.49	0.49	0.53	0.63	3.860	0.32	0.14	0.18	0.75
Lu	0.002	<0.001	0.002.	0.002	0.002	0.002	0.038	0.002	<0.001	0.002	0.003
Mn	61	47	76	88	75	81	590.000	114	8	13	96
Nd	0.38	0.09	0.3	0.36	0.32	0.32	2.240	0.24	0.07	0.14	0.55
Pb	1.11	0.3	0.55	1.52	0.29	0.42	3.790	0.47	0.66	1.52	1.24
Pr	0.101	0.024	0.078	0.094	0.081	0.086	0.624	0.067	0.015	0.033	0.137
Tb	0.007	0.002	0.005	0.008	0.006	0.006	0.109	0.006	0.002	0.004	0.01
TM	0.003	<0.001	0.002	0.002	0.002	0.002	0.054	0.002	<0.001	0.002	0.003
U	0.01	0.013	0.124	0.057	0.067	0.06	1.218	0.016	0.08	0.101	0.079
V	1.11	0.75	0.6	0.67	0.61	0.61	2.06	0.9	0.28	0.28	0.94
Y	0.29	0.07	0.18	0.2	0.21	0.22	4.990	0.15	0.06	0.12	0.32
Yb	0.019	0.005	0.01	0.013	0.013	0.013	0.294	0.012	0.006	0.015	0.018
Zn	8.8	8.1	9.7	10.6	112	11.9	194.200	7	7.7	12.1	8.2

Table 9.2. Concentration (ppb or µg/L) of various elements in samples from 1991, numbers in brackets refer to locations in Figure 1.

Element	*Charles (57)*	*Chocolate (83)*	*Colbart (32)*	*Cranberry (80)*	*First (71)*	*First (71)*	*First (72)*	*First (72)*	*First Chain (27)*	*Fletcher (35)*	*Fletcher (36)*
As	6.3	0.500	0.1	0.3	0.5	0.4	0.3	0.1	0.1	0.7	0.8
Cd	0.48	0.300	0.1	0.05	0.04	0.03	0.03	0.06	0.46	0.48	0.28
Ce	0.48	2.920	0.31	0.07	27	0.13	0.12	0.1	3.25	0.6	0.43
Cu	2.1	6.100	2.7	1.6	1.7	1.3	1.3	1.8	4.9	1.3	1
Dy	0.027	0.231	0.031	0.009	0.029	0.013	0.016	0.01	0.29	0.032	0.029
Er	0.015	0.137	0.02	0.007	0.015	0.008	0.011	0.006	0.177	0.019	0.018
Eu	0.013	0.079	0.009	0.003	0.01	0.005	0.008	0.004	0.086	0.013	0.012
Fe	180	1099.000	120	70	494	352	149	210	257	142	103
Gd	0.062	0.264	0.05	0.021	0.055	0.027	0.033	0.019	0.41	0.069	0.063
Ho	0.006	0.050	0.007	0.002	0.005	0.003	0.003	0.002	0.061	0.007	0.006
In	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
La	0.51	1.990	0.17	0.11	2	0.1	0.11	0.16	2.13	0.49	0.32
Lu	0.002	0.018	0.002	<0.001	0.002	<0.001	0.002	0.001	0.018	0.002	0.002
Mn	90	349.000	24	23	41	33	34	35	279	74	67
Nd	0.33	1.330	0.15	0.08	0.19	0.09	0.1	0.08	1.41	0.33	0.24
Pb	0.75	3.800	1.94	0.34	3.59	1	0.27	1.07	3.6	1.47	0.86
Pr	0.085	0.355	0.043	0.02	0.044	0.022	0.024	0.018	0.381	0.085	0.065
Tb	0.005	0.042	0.006	0.002	0.006	0.003	0.004	0.002	0.054	0.008	0.005
TM	0.002	0.020	0.003	<0.001	0.002	<0.001	0.001	<0.001	0.024	0.002	0.002
U	0.036	0.340	0.181	0.021	0.074	0.059	0.064	0.061	0.652	0.042	0.038
V	0.56	1.87	1.24	0.29	0.45	0.35	0.3	0.19	0.54	0.37	23
Y	0.19	1.900	0.15	0.07	0.12	0.07	0.09	0.07	1.93	0.15	0.15
Yb	0.013	0.111	0.016	0.006	0.013	0.006	0.009	0.005	0.135	0.013	0.013
Zn	9	95.100	20.1	7.5	6.9	4.7	3.6	5.9	83.9	8.3	12.6

Table 9.3. Concentration (ppb or µg/L) of various elements in samples from 1991, numbers in brackets refer to locations in Figure 1.

Element	*Fletcher (37)*	*Fraser (23)*	*Fraser (24)*	*Frenchman (67)*	*Frog Pond (85)*	*Governor (21)*	*Governor (22)*	*Grand (1)*	*Grand (2)*	*Grand (3)*	*Kearny (17)*	*Kearny (18)*
As	0.7	2	0.2	0.3	0.300	2	0.2	2	0.2	0.4	0.2	0.1
Cd	0.22	0.08	0.1	0.3	0.060	0.35	0.32	0.3	0.19	0.06	0.11	0.09
Ce	0.52	0.24	0.26	0.24	0.430	1.64	1.6	0.16	0.15	2	0.85	0.5
Cu	1.2	1.7	1.1	1.3	2.200	5	4.1	5.6	2.8	1.2	2	1.8
Dy	0.037	0.025	0.026	0.024	0.035	0.194	0.175	0.015	0.014	0.016	0.059	0.045
Er	0.019	0.014	0.016	0.013	0.025	0.109	0.109	0.008	0.008	0.009	0.037	0.03
Eu	0.014	0.008	0.009	0.007	0.012	0.05	0.044	0.006	0.006	0.006	0.019	0.013
Fe	150	168	201	199	1265.000	361	409	96	45	54	1002	116
Gd	0.09	0.036	0.043	0.037	0.055	0.233	0.209	0.023	0.029	0.03	0.11	0.083
Ho	0.007	0.005	0.005	0.005	0.008	0.039	0.036	0.003	0.003	0.003	0.012	0.009
In	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
La	0.42	0.13	0.14	0.31	0.280	0.99	0.95	0.12	0.12	0.15	0.5	0.39
Lu	0.002	0.001	0.002	0.001	0.004	0.012	0.01	<0.001	<0.001	0.001	0.004	0.003
Mn	70	69	68	61	38.000	209	218	23	17	18	69	59
Nd	0.31	0.13	0.14	0.2	0.250	0.73	0.69	0.11	0.11	0.14	0.44	0.28
Pb	1	0.97	0.86	1.38	0.770	2.12	1.55	1.85	1.51	0.64	4.22	5.25
Pr	0.081	0.033	0.034	0.057	0.063	0.189	0.175	0.028	0.028	0.035	0.113	0.071
Tb	0.008	0.005	0.005	0.004	0.007	0.032	0.031	0.003	0.004	0.004	0.012	0.009
TM	0.003	0.002	0.002	0.002	0.004	0.015	0.014	0.001	0.001	0.001	0.005	0.004
U	0.04	0.091	0.079	0.012	0.056	0.486	0.431	0.016	0.013	0.018	0.08	0.054
V	26	0.62	0.62	2.95	2.16	0.48	0.76	0.29	0.14	0.12	2.66	0.81
Y	0.17	0.15	0.17	0.16	0.310	1.45	1.38	0.11	0.07	0.08	0.39	0.34
Yb	0.013	0.011	0.013	0.012	0.025	0.86	0.075	0.007	0.006	0.009	0.029	0.022
Zn	10.4	14.1	16.5	18.3	20.600	84.3	82.5	30.7	15	14.1	17.4	13.1

Table 9.4. Concentration (ppb or µg/L) of various elements in samples from 1991, numbers in brackets refer to locations in Figure 1.

Element	*Kinsac (4)*	*Kinsac (5)*	*Kinsac (6)*	*Little Albro (78)*	*Lamont (73)*	*Long (28)*	*Long (29)*	*Long (30)*	*Loon (54)*	*Loon (55)*	*Major (50)*
As	0.1	0.1	0.2	0.9	0.3	0.400	0.2	0.3	0.3	0.300	0.1
Cd	0.11	0.08	0.29	0.04	0.05	0.110	0.11	0.43	0.34	0.910	0.1
Ce	0.3	0.36	0.55	0.23	0.56	1.640	1.13	1.38	0.59	0.280	0.49
Cu	1.5	7	2.9	1.6	1.3	4.800	1.5	7.9	2.4	2.700	2
Dy	0.023	0.021	0.037	0.015	0.03	0.126	0.097	0.106	0.034	0.021	0.032
Er	0.014	0.011	0.021	0.009	0.02	0.082	0.063	0.071	0.017	0.010	0.018
Eu	0.01	0.008	0.014	0.007	0.011	0.038	0.028	0.033	0.014	0.008	0.011
Fe	121	197	339	395	256	842.000	217	203	254	387.000	224
Gd	0.043	0.036	0.057	0.042	0.063	0.186	0.139	0.153	0.07	0.034	0.059
Ho	0.005	0.004	0.007	0.003	0.006	0.030	0.022	0.025	0.006	0.004	0.007
In	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.006	<0.001
La	0.21	0.2	0.36	0.18	0.47	0.930	0.65	0.84	0.52	0.280	0.41
Lu	0.001	0.001	0.002	0.001	0.002	0.009	0.007	0.008	0.002	0.002	0.002
Mn	107	77	106	31	45	135.000	138	134	88	83.000	64
Nd	0.17	0.17	0.3	0.16	0.3	0.730	0.46	0.58	0.38	0.180	0.24
Pb	0.91	1.36	1.18	4.47	0.77	4.660	1.91	5.06	1.79	10.280	2.82
Pr	0.043	0.045	0.076	0.041	0.082	0.201	0.125	0.157	0.097	0.044	0.068
Tb	0.005	0.005	0.008	0.004	0.007	0.024	0.02	0.021	0.007	0.004	0.006
TM	0.002	0.002	0.002	0.001	0.002	0.011	0.008	0.01	0.002	0.002	0.003
U	0.016	0.016	0.03	0.034	0.074	0.251	0.196	0.251	0.066	0.024	0.077
V	0.23	0.45	0.52	1.89	0.94	2.16	0.77	0.79	0.81	1.12	1.44
Y	0.16	0.11	0.22	0.09	0.22	0.750	0.56	0.72	0.21	0.110	0.19
Yb	0.011	0.009	0.012	0.007	0.014	0.063	0.051	0.058	0.014	0.010	0.014
Zn	21.1	11.3	21	10	5.6	31.600	26.8	28.9	8.7	8.800	6

Table 9.5. Concentration (ppb or µg/L) of various elements in samples from 1991, numbers in brackets refer to locations in Figure 1.

Element	*Major (51)*	*Major (52)*	*Major (52)*	*Major (53)*	*Maynard (77)*	*Micmac (58)*	*Micmac (59)*	*Miller (46)*	*Miller (47)*	*Morris (62)*	*Morris (63)*
As	0.4	0.3	0.1	0.2	0.2	2.9	2.8	0.2	0.1	0.2	0.2
Cd	0.12	0.17	0.38	0.07	0.08	0.47	0.21	0.15	0.2	0.19	0.3
Ce	0.69	0.48	0.43	0.57	0.37	0.41	0.27	0.67	0.79	0.33	0.45
Cu	1.9	1.6	4	1.6	0.9	3.1	2.5	1.2	1.5	2.2	1.9
Dy	0.04	0.03	0.029	0.032	0.022	0.032	0.026	0.039	0.047	0.033	0.032
Er	0.022	0.017	0.015	0.019	0.014	0.016	0.014	0.02	0.029	0.017	0.017
Eu	0.015	0.01	0.009	0.011	0.009	0.013	0.01	0.015	0.019	0.012	0.014
Fe	393	183	131	239	569	220	59	127	141	192	278
Gd	0.09	0.067	0.057	0.054	0.056	0.066	0.054	0.086	0.136	0.061	0.07
Ho	0.008	0.006	0.006	0.007	0.004	0.007	0.005	0.007	0.009	0.007	0.006
In	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
La	0.51	0.45	0.34	0.51	0.22	0.47	0.4	0.46	0.44	0.36	0.38
Lu	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.002
Mn	63	65	62	68	69	72	65	130	127	137	96
Nd	0.38	0.25	0.23	0.25	0.22	0.32	0.26	0.3	0.38	0.27	0.31
Pb	2.15	1.91	2.24	1.12	0.43	1.15	0.67	1.45	0.93	1.2	1.42
Pr	0.092	0.062	0.061	0.069	0.057	0.085	0.064	0.08	0.098	0.067	0.08
Tb	0.008	0.006	0.005	0.006	0.005	0.006	0.005	0.01	0.011	0.006	0.007
TM	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.002
U	0.115	0.079	0.08	0.12	0.044	0.05	0.045	0.055	0.069	0.055	0.05
V	1.5	1	1	1.28	0.99	0.96	0.62	0.2	0.23	0.82	0.84
Y	0.22	0.14	0.15	0.17	0.12	0.21	0.16	0.17	0.21	0.18	0.18
Yb	0.019	0.012	0.011	0.012	0.01	0.015	0.012	0.014	0.021	0.016	0.014
Zn	6.7	8.7	8.8	10.1	22.5	20.2	8.4	10.2	12.6	10.7	9.9

Table 9.6. Concentration (ppb or µg/L) of various elements in samples from 1991, numbers in brackets refer to locations in Figure 1.

Element	*Morris (64)*	*Oathill (75)*	*Oathill (75)*	*Oathill (75)*	*PaperMill (16)*	*Parr (33)*	*Penhorn (76)*	*Powder Mill (11)*	*Power Pond (86)*	*Rocky (12)*	*Rocky (13)*
As	0.2	0.2	0.3	0.4	0.2	0	0.2	0.9	0.4	0.3	0.3
Cd	0.15	0.09	0.07	0.08	0.11	0.06	0.06	0.08	0.12	0.05	0.07
Ce	0.46	0.13	0.12	0.09	0.48	21	0.06	0.13	1.02	0.21	0.16
Cu	2.2	2.6	2.4	2.3	1.5	0.8	1.7	1.4	2.2	1.3	1.3
Dy	0.029	0.017	0.017	0.013	0.043	0.022	0.007	0.014	0.075	0.024	0.015
Er	0.017	0.012	0.011	0.009	0.027	0.011	0.006	0.008	0.047	0.017	0.01
Eu	0.013	0.007	0.006	0.005	0.013	0.005	0.003	0.006	0.021	0.007	0.006
Fe	236	115	128	62	148	126	68	81	310	228	118
Gd	0.075	0.032	0.034	0.022	0.081	0.029	0.013	0.031	0.141	0.035	0.028
Ho	0.007	0.004	0.004	0.003	0.009	0.004	0.2	0.003	0.017	0.005	0.003
In	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
La	0.43	0.18	0.15	0.12	0.37	0.11	0.07	0.13	0.6	0.2	0.17
Lu	0.002	0.001	0.001	0.001	0.003	0.001	<0.001	<0.001	0.005	0.002	<0.001
Mn	118	71	74	77	54	16	27	17	107	17	8
Nd	0.28	0.14	0.12	0.1	0.28	0.11	0.06	0.11	0.48	0.16	0.13
Pb	1	0.2	0.28	0.26	1.81	1.61	0.25	0.8	1.96	1.28	1.13
Pr	0.07	0.036	0.03	0.024	0.069	0.028	0.015	0.027	0.123	0.04	0.033
Tb	0.006	0.004	0.004	0.003	0.009	0.003	0.002	0.004	0.015	0.004	0.003
TM	0.002	0.001	0.001	<0.001	0.004	0.001	<0.001	0.001	0.006	0.002	0.001
U	0.045	0.076	0.036	0.03	0.049	0.082	0.051	0.038	0.217	0.068	0.084
V	0.88	0.46	0.56	0.45	0.8	0.91	0.45	0.21	1.16	0.72	0.37
Y	0.17	0.14	0.12	0.1	0.33	0.12	0.06	0.11	0.57	0.19	0.11
Yb	0.015	0.009	0.01	0.008	0.02	0.009	0.005	0.007	0.035	0.013	0.007
Zn	8.4	16.6	11.4	26.1	11.9	13.7	8.8	8.6	31.5	12.1	7.6

Table 9.7. Concentration (ppb or µg/L) of various elements in samples from 1991, numbers in brackets refer to locations in Figure 1.

Element	*Russell (65)*	*Russell (66)*	*Sandy (14)*	*Sandy (15)*	*Second (10)*	*Second (9)*	*SecondChain (26)*	*Settle (81)*	*Soldier (43)*	*Soldier (44)*	*Soldier (45)*
As	0.2	0.3	0.1	0.2	0.2	0.2	0.200	0.4	0	0.1	0.3
Cd	0.27	0.24	0.14	0.13	0.08	0.15	0.370	0.07	0.1	0.43	0.13
Ce	0.3	0.29	1.03	1.03	0.26	0.14	4.230	0.27	1.04	0.87	1.11
Cu	1.7	1.8	3.6	2	1.3	2.2	6.400	3	1.4	4.7	2.2
Dy	0.021	0.02	0.076	0.07	0.028	0.015	0.436	0.033	0.055	0.043	0.074
Er	0.012	0.012	0.041	0.044	0.015	0.009	0.252	0.021	0.026	0.018	0.036
Eu	0.008	0.009	0.024	0.025	0.011	0.006	0.137	0.014	0.021	0.017	0.025
Fe	217	201	175	418	100	116	711.000	185	227	200	386
Gd	0.035	0.045	0.129	0.144	0.054	0.027	0.598	0.068	0.144	0.103	0.182
Ho	0.005	0.005	0.015	0.015	0.005	0.003	0.090	0.007	0.01	0.008	0.013
In	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001
La	0.29	0.27	0.69	0.65	0.18	0.1	2.530	0.28	0.52	0.48	0.59
Lu	0.002	0.002	0.004	0.004	0.002	<0.001	0.028	0.002	0.003	0.002	0.004
Mn	658	658	196	188	37	17	338.000	108	143	133	147
Nd	21	0.2	0.55	0.55	0.2	0.11	2.010	0.26	0.44	0.35	0.5
Pb	1.03	1.12	1.86	1.74	0.78	0.68	4.110	1.51	1.4	1.81	6.68
Pr	0.052	0.052	0.142	0.138	0.048	0.026	0.531	0.065	0.115	0.096	0.129
Tb	0.005	0.005	0.016	0.016	0.007	0.004	0.075	0.008	0.012	0.01	0.015
TM	0.002	0.002	0.005	0.006	0.002	0.001	0.034	0.003	0.003	0.003	0.004
U	0.022	0.02	0.039	0.038	0.041	0.009	0.917	0.079	0.086	0.062	0.14
V	0.9	0.81	0.41	0.92	0.2	0.33	1.34	0.34	0.48	0.42	1.49
Y	0.14	0.12	0.49	0.46	0.13	0.09	2.590	0.23	0.22	0.21	0.3
Yb	0.011	0.011	0.033	0.028	0.01	0.007	0.197	0.015	0.018	0.016	0.028
Zn	12.8	12	23.7	22.1	16.8	11.6	94.900	11.6	12.9	58.9	14.7

Table 9.8. Concentration (ppb or µg/L) of various elements in samples from 1991, numbers in brackets refer to locations in Figure 1.

Element	*Spider (48)*	*Spider (49)*	*Spruce Hill (34)*	*Susie (19)*	*Susie (20)*	*Third (8)*	*Third (7)*	*Thomas (38)*	*Thomas (39)*	*Topsall (74)*	*Whimsical (84)*
As	0.6	0.1	0.2	0.1	0.7	0.2	0.2	0.7	1.7	0.2	0.3
Cd	0.11	0.1	0.06	0.08	0.11	0.09	0.21	0.25	0.2	0.13	0.14
Ce	1.25	0.55	0.28	0.21	0.57	0.36	0.24	0.6	0.3	0.34	0.39
Cu	0.9	1.4	1.1	1.9	3	1.6	2.3	1	0.8	3.1	4
Dy	0.062	0.035	0.022	0.023	0.057	0.026	0.027	0.039	0.031	0.022	0.035
Er	0.029	0.023	0.013	0.013	0.032	0.012	0.013	0.022	0.016	0.014	0.029
Eu	0.024	0.012	0.006	0.006	0.013	0.01	0.011	0.016	0.011	0.008	0.009
Fe	736	79	202	142	494	119	96	144	61	82	160
Gd	0.157	0.104	0.04	0.035	0.09	0.05	0.046	0.113	0.069	0.043	0.061
Ho	0.011	0.008	0.005	0.004	0.011	0.005	0.005	0.006	0.006	0.005	0.009
In	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
La	0.7	0.51	0.13	0.12	0.35	0.26	0.19	0.44	0.56	0.3	0.42
Lu	0.003	0.002	0.001	0.001	0.004	0.001	0.001	0.002	0.002	0.001	0.004
Mn	83	64	35	54	68	17	21	83	32	45	85
Nd	0.68	0.33	0.12	0.12	0.35	0.21	0.19	0.38	0.28	0.2	0.25
Pb	3.06	1.57	1.26	1.01	3.89	0.5	2.14	0.65	2.38	0.94	1.03
Pr	0.166	0.089	0.032	0.029	0.085	0.058	0.044	0.092	0.067	0.056	0.066
Tb	0.013	0.007	0.004	0.005	0.01	0.006	0.006	0.009	0.005	0.005	0.007
TM	0.004	0.003	0.002	0.002	0.005	0.002	0.002	0.003	0.002	0.002	0.004
U	0.049	0.009	0.052	0.057	0.241	0.046	0.046	0.044	0.025	0.053	0.098
V	2.18	0.65	0.61	1.16	3.31	0.35	0.2	0.32	0.25	0.72	1.03
Y	0.22	0.15	0.13	0.15	0.57	0.11	0.17	0.19	0.13	0.16	0.38
Yb	0.023	0.015	0.011	0.011	0.026	0.007	0.009	0.017	0.01	0.012	0.027
Zn	8.9	8.5	10.5	10.9	13.8	20.4	21.1	8.6	7.5	12.2	35.7

Table 9.9. Concentration (ppb or µg/L) of various elements in samples from 1991, numbers in brackets refer to locations in Figure 1.

Element	*William (40)*	*William (41)*	*William (42)*
As	1	0.2	0.9
Cd	0.15	0.08	0.24
Ce	0.31	0.21	0.34
Cu	1	1.5	0.9
Dy	0.027	0.021	0.032
Er	0.015	0.013	0.019
Eu	0.011	0.007	0.013
Fe	43	110	83
Gd	0.069	0.028	0.087
Ho	0.006	0.004	0.006
In	<0.001	<0.001	<0.001
La	0.39	0.16	0.53
Lu	0.002	0.002	0.002
Mn	30	19	31
Nd	0.26	0.11	0.31
Pb	1.72	1.38	2.15
Pr	0.07	0.032	0.074
Tb	0.006	0.004	0.006
TM	0.002	0.002	0.002
U	0.021	0.092	0.023
V	0.28	0.79	0.32
Y	0.13	0.17	0.13
Yb	0.011	0.011	0.012
Zn	12.3	16.2	8.9

APPENDIX E - Elemental Data Collected in 2000

Table 10. Concentration (ppb or µg/L) of various elements in samples from 2000, numbers in brackets refer to locations in Figure 1.

Element	Anderson (68)	Big Albro (79)	Banook (69)	Banook (70)	Banook (70)	Banook (70)	Bayers (25)	Bell (82)
Ag	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Al	119	16	19	23	23	22	170	48
As	0.2	0.6	1.6	1.7	1.6	1.7	0.2	0.2
B	3.3	3.7	9.1	9.9	9.8	10.1	11.6	3.7
Ba	8.4	5.5	13.4	13	13	13	37.8	14.3
Be	0.021	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.158	0.022
Bi	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cd	0.14	< 0.010	0.017	0.013	0.019	0.029	0.68	0.052
Ce	0.28	0.04	0.09	0.09	0.09	0.08	0.23	0.12
Co	0.2	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	2.34	0.13
Cr	0.12	0.23	0.38	0.36	0.38	0.36	0.18	< 0.10
Cs	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05	< 0.01
Cu	0.7	1.3	1.3	1.4	1.4	1.4	18.1	0.9
Dy	0.027	< 0.005	0.01	0.013	0.011	0.013	0.025	0.009
Er	0.019	< 0.005	0.006	0.005	0.008	0.007	0.013	< 0.005
Eu	0.007	< 0.005	< 0.005	0.005	< 0.005	< 0.005	0.008	< 0.005
Fe	52	35	28	34	32	34	87	8
Gd	0.031	< 0.005	0.025	0.013	0.016	0.021	0.028	0.013
Ho	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.007	< 0.005
In	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
La	0.25	0.04	0.13	0.12	0.13	0.13	0.16	0.09
Li	0.545	0.312	0.418	0.419	0.421	0.422	4.128	0.308
Lu	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Mn	50.7	25.5	30.1	31.9	32.4	32.5	503.8	32.1
Mo	< 0.05	0.18	0.09	0.11	0.1	0.1	< 0.05	< 0.05
Nd	0.213	0.028	0.094	0.09	0.093	0.098	0.126	0.066
Ni	0.8	0.6	0.5	0.5	0.7	0.5	8.2	1.1
Pb	0.17	0.1	0.1	0.09	0.1	0.09	2.74	0.22
Pr	0.052	0.009	0.023	0.023	0.025	0.025	0.025	0.022
Rb	0.74	0.98	1.25	1.27	1.27	1.25	2.92	0.72
Re	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Sb	0.01	0.06	0.17	0.16	0.16	0.17	0.27	0.04
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sm	0.03	0.007	0.019	0.017	0.018	0.02	0.028	0.014
Sr	10.5	34.8	51.7	53	53	53.7	53.8	11
Tb	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Th	0.009	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.008	< 0.005
Ti	0.7	< 0.5	< 0.5	0.5	0.6	< 0.5	0.7	< 0.5
Tl	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.019	< 0.005
Tm	< 0.005	< 0.005	< 0.005	< 0.005	0.006	< 0.005	< 0.005	< 0.005
U	< 0.005	0.007	0.031	0.028	0.029	0.028	0.034	< 0.005
V	0.69	1.06	0.62	0.59	0.64	0.64	0.19	0.3
Y	0.17	0.03	0.08	0.08	0.08	0.08	0.2	0.05
Yb	0.015	< 0.005	0.008	0.006	0.006	0.007	0.017	0.006
Zn	4.8	2.1	2.7	2.6	2.5	2.5	89.9	2.4

Table 10-2. Concentration (ppb or µg/L) of various elements in samples from 2000, numbers in brackets refer to locations in Figure 1.

Element	Bissett (60)	Bissett (61)	Charles (56)	Charles (57)	Chocolate (83)	Colbart (32)	Cranberry (80)	First Chain (27)
Ag	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Al	31	34	34	34	38	214	21	777
As	0.6	0.5	6.4	6.4	< 0.1	0.3	0.3	< 0.1
B	5	5.4	4.8	4.8	5.4	8.1	5	3.3
Ba	19.4	20	11.1	11.2	23.4	5.3	14.4	19.9
Be	< 0.005	< 0.005	0.008	0.007	0.078	0.073	< 0.005	0.165
Bi	0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cd	0.072	0.054	0.101	0.068	0.127	0.213	0.031	0.179
Ce	0.1	0.12	0.19	0.2	0.23	0.2	0.06	0.5
Co	< 0.05	< 0.05	0.08	0.08	2.44	0.09	< 0.05	2.78
Cr	0.48	0.48	0.19	0.2	0.1	0.22	0.33	< 0.10
Cs	< 0.01	< 0.01	< 0.01	< 0.01	0.1	0.05	< 0.01	0.1
Cu	2.1	2.2	1.2	1.1	1.1	1.3	1.1	1
Dy	0.012	0.01	0.017	0.022	0.01	0.019	0.006	0.05
Er	< 0.005	0.005	0.013	0.011	0.009	0.009	< 0.005	0.029
Eu	< 0.005	< 0.005	0.007	0.01	< 0.005	< 0.005	< 0.005	0.013
Fe	56	58	36	35	36	116	35	46
Gd	0.014	0.011	0.03	0.027	0.016	0.036	0.011	0.053
Ho	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.01
In	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
La	0.08	0.08	0.21	0.22	0.25	0.11	0.05	0.45
Li	0.482	0.486	0.503	0.487	4.225	1.366	0.513	4.976
Lu	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Mn	23.9	15.9	69.4	71.2	136	14	10.5	116.3
Mo	0.13	0.12	0.11	0.08	< 0.05	< 0.05	< 0.05	< 0.05
Nd	0.068	0.082	0.17	0.169	0.076	0.113	0.054	0.232
Ni	0.4	0.6	0.4	0.4	5.7	0.6	0.3	5.6
Pb	0.14	0.15	0.12	0.15	0.13	0.56	0.12	1.27
Pr	0.015	0.021	0.042	0.046	0.023	0.023	0.012	0.063
Rb	1.47	1.48	1.4	1.49	2.84	1.38	1.63	1.99
Re	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Sb	0.1	0.09	0.1	0.1	0.02	0.08	0.05	0.01
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sm	0.014	0.009	0.031	0.022	0.009	0.021	0.015	0.042
Sr	53.7	55.4	36.4	37.2	48.2	20.4	47.8	27.3
Tb	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.006
Th	0.016	0.015	< 0.005	0.007	< 0.005	0.019	< 0.005	< 0.005
Ti	0.8	0.7	0.7	0.6	< 0.5	1.8	< 0.5	0.5
Tl	< 0.005	< 0.005	< 0.005	< 0.005	0.014	< 0.005	< 0.005	0.011
Tm	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
U	0.038	0.035	0.045	0.052	< 0.005	0.069	0.007	0.019
V	0.18	0.17	0.47	0.44	< 0.10	0.91	0.21	0.12
Y	0.06	0.06	0.14	0.14	0.16	0.12	0.04	0.43
Yb	0.007	0.007	0.006	0.011	0.007	0.01	< 0.005	0.02
Zn	2.3	2.7	1.9	1.8	19.4	6.7	1.4	17

Table 10-3. Concentration (ppb or µg/L) of various elements in samples from 2000, numbers in brackets refer to locations in Figure 1.

Element	First (71)	First (72)	Fletcher (35)	Fletcher (36)	Fletcher (37)	Fraser (23)	Frenchman (67)	Frog Pond (85)
Ag	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Al	13	14	99	98	93	276	113	70
As	0.4	0.4	1	1.1	1.2	0.3	0.5	0.6
B	5.1	5	4.2	4.3	3.9	3.5	2.8	9.1
Ba	30.6	31.2	15	14.1	12.7	14.8	17.1	13.9
Be	< 0.005	< 0.005	0.026	0.023	0.024	0.08	0.011	0.016
Bi	0.01	< 0.01	< 0.01	< 0.01	0.02	< 0.01	< 0.01	< 0.01
Cd	0.102	0.158	0.167	0.172	0.223	0.108	0.085	0.01
Ce	0.05	0.04	0.47	0.43	0.39	0.25	0.21	0.08
Co	< 0.05	< 0.05	0.6	0.63	0.54	0.33	0.34	0.12
Cr	0.33	0.32	0.26	0.22	0.21	0.22	0.34	0.31
Cs	< 0.01	< 0.01	0.01	0.01	0.01	0.03	< 0.01	0.06
Cu	1.2	1.4	1	1.1	0.9	0.5	1.1	1.4
Dy	0.005	0.006	0.048	0.044	0.043	0.039	0.017	0.01
Er	< 0.005	< 0.005	0.024	0.021	0.022	0.017	0.014	0.008
Eu	< 0.005	< 0.005	0.013	0.011	0.009	0.006	0.008	< 0.005
Fe	14	16	119	119	118	179	110	119
Gd	0.007	0.013	0.062	0.064	0.042	0.032	0.024	0.016
Ho	< 0.005	< 0.005	0.007	0.009	0.008	0.006	< 0.005	< 0.005
In	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
La	0.03	0.03	0.32	0.31	0.27	0.15	0.2	0.06
Li	0.612	0.617	0.843	0.796	0.788	1.37	0.457	1.655
Lu	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Mn	19.3	20.8	64.3	67.4	62.4	55.7	126.3	48.9
Mo	0.1	0.13	< 0.05	< 0.05	< 0.05	< 0.05	0.08	0.87
Nd	0.032	0.025	0.285	0.268	0.24	0.155	0.142	0.051
Ni	0.4	0.5	2.3	2.2	1.9	1	2	1
Pb	0.07	0.07	0.2	0.32	0.29	0.55	0.61	0.38
Pr	0.006	0.007	0.073	0.066	0.057	0.035	0.041	0.011
Rb	1.43	1.49	1.13	1.14	1.12	1.38	1.06	2.74
Re	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Sb	0.11	0.1	0.06	0.05	0.07	0.03	0.1	0.15
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sm	0.008	0.01	0.055	0.054	0.037	0.034	0.027	0.014
Sr	47.5	48.9	23.1	23.3	22.5	11.4	39.9	62.5
Tb	< 0.005	< 0.005	0.007	0.007	0.007	0.005	< 0.005	< 0.005
Th	0.009	< 0.005	0.009	0.012	0.018	0.021	0.006	0.007
Ti	< 0.5	< 0.5	0.9	0.7	1.1	1.8	0.7	1.1
Tl	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.006	< 0.005	0.006
Tm	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
U	0.026	0.03	0.048	0.043	0.044	0.1	0.007	0.046
V	0.11	< 0.10	0.22	0.25	0.27	0.65	4.05	1.72
Y	0.03	0.03	0.22	0.22	0.19	0.17	0.13	0.1
Yb	< 0.005	0.006	0.018	0.019	0.018	0.016	0.01	0.014
Zn	2	2.1	5.5	6.6	6.2	7	14.6	4.7

Table 10-4. Concentration (ppb or µg/L) of various elements in samples from 2000, numbers in brackets refer to locations in Figure 1.

Element	Governor (21)	Governor (22)	Governor (22)	Grand (1)	Grand (2)	Grand (3)	Kearny (17)	Kearny (18)
Ag	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Al	231	212	239	65	62	67	189	187
As	0.3	0.3	0.3	0.5	0.4	0.4	0.2	0.2
B	5.6	5.2	5	4.2	3.9	3.8	3.7	4
Ba	42.2	41	41.5	11.2	10.6	10.4	13.5	13.2
Be	0.222	0.206	0.216	0.014	0.014	0.009	0.066	0.074
Bi	< 0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cd	0.326	0.229	0.386	0.131	0.149	0.188	0.127	0.258
Ce	0.43	0.41	0.4	0.18	0.17	0.2	0.21	0.2
Co	0.84	0.78	0.73	0.06	0.07	0.1	0.18	0.18
Cr	0.24	0.26	0.26	0.21	0.17	0.15	0.19	0.19
Cs	0.1	0.1	0.1	< 0.01	< 0.01	< 0.01	0.06	0.05
Cu	2.1	1.9	2	0.9	0.8	0.7	0.8	0.8
Dy	0.067	0.064	0.055	0.017	0.027	0.019	0.022	0.026
Er	0.029	0.029	0.029	0.011	0.009	0.015	0.014	0.013
Eu	0.011	0.013	0.014	< 0.005	0.007	< 0.005	0.008	< 0.005
Fe	139	140	143	44	40	44	98	97
Gd	0.067	0.059	0.071	0.021	0.021	0.033	0.02	0.023
Ho	0.012	0.01	0.012	< 0.005	< 0.005	< 0.005	< 0.005	0.005
In	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
La	0.27	0.23	0.23	0.13	0.14	0.14	0.14	0.13
Li	3.207	3.086	3.229	0.691	0.636	0.643	1.307	1.398
Lu	< 0.005	< 0.005	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Mn	114.2	105.6	114.6	19.1	19.5	24.3	46.1	43.9
Mo	0.06	0.06	0.06	< 0.05	< 0.05	< 0.05	0.08	0.09
Nd	0.27	0.255	0.261	0.131	0.131	0.132	0.109	0.119
Ni	2.6	2.4	2.4	0.9	0.8	0.8	0.7	0.7
Pb	0.71	0.66	0.56	0.17	0.16	0.13	0.42	0.32
Pr	0.057	0.058	0.06	0.03	0.033	0.03	0.033	0.031
Rb	2.82	2.74	2.71	0.88	0.81	0.83	1.46	1.45
Re	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Sb	0.1	0.11	0.1	0.03	0.03	0.03	0.05	0.05
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sm	0.063	0.054	0.06	0.02	0.025	0.031	0.024	0.029
Sr	46.6	44.4	43.8	23.1	19.5	19.2	22.2	23.9
Tb	0.01	0.009	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Th	0.015	0.021	0.017	0.005	< 0.005	0.009	0.007	0.008
Ti	1.3	1.4	1.3	< 0.5	< 0.5	< 0.5	1.2	1
Tl	0.009	0.007	0.011	< 0.005	< 0.005	< 0.005	0.006	0.006
Tm	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
U	0.265	0.276	0.262	0.02	0.019	0.019	0.083	0.092
V	0.26	0.29	0.34	0.11	0.12	0.13	0.56	0.55
Y	0.4	0.37	0.38	0.11	0.1	0.1	0.15	0.15
Yb	0.035	0.03	0.027	0.007	0.007	0.009	0.011	0.016
Zn	26.4	24.6	25.8	3.3	3.4	3.5	5.9	6.7

Table 10-5. Concentration (ppb or µg/L) of various elements in samples from 2000, numbers in brackets refer to locations in Figure 1.

Element	Kinsac (4)	Kinsac (5)	Kinsac (6)	Little Albro (78)	Lamont (73)	Long (28)	Long (29)	Long (30)
Ag	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Al	144	145	147	24	123	231	239	241
As	0.2	0.2	0.2	1.5	0.2	0.3	0.3	0.3
B	3	3.5	3.6	3.8	3	4	3.9	3.8
Ba	9.2	14.5	14.7	5.1	11.5	12	11.5	11.4
Be	0.018	0.026	0.031	< 0.005	0.053	0.093	0.091	0.082
Bi	< 0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.02	< 0.01
Cd	0.1	0.644	0.241	0.014	0.08	0.171	0.205	0.114
Ce	0.33	0.29	0.29	0.1	0.18	0.33	0.33	0.31
Co	0.39	0.26	0.26	0.08	0.4	0.5	0.51	0.46
Cr	0.22	0.22	0.24	0.29	< 0.10	0.23	0.21	0.21
Cs	< 0.01	< 0.01	< 0.01	< 0.01	0.02	0.05	0.05	0.05
Cu	0.6	0.8	0.8	1.2	0.8	0.9	0.9	1.4
Dy	0.029	0.023	0.027	0.007	0.01	0.032	0.031	0.033
Er	0.014	0.016	0.019	< 0.005	0.008	0.019	0.02	0.019
Eu	0.008	0.01	0.008	< 0.005	< 0.005	0.007	0.011	0.009
Fe	86	109	114	35	28	183	189	185
Gd	0.037	0.034	0.034	0.013	0.021	0.056	0.04	0.041
Ho	< 0.005	0.006	< 0.005	< 0.005	< 0.005	0.007	0.006	0.006
In	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
La	0.19	0.18	0.2	0.07	0.17	0.18	0.18	0.18
Li	0.607	0.687	0.706	0.343	0.841	2.177	2.109	2.076
Lu	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Mn	69.5	63.1	63.3	19.4	80.3	61.8	60.2	59.3
Mo	< 0.05	< 0.05	0.08	0.36	< 0.05	< 0.05	< 0.05	< 0.05
Nd	0.184	0.198	0.185	0.064	0.122	0.158	0.19	0.199
Ni	1.1	0.9	1	0.6	1.6	1.7	1.8	1.8
Pb	0.22	0.32	0.24	0.15	0.39	0.41	0.43	1.9
Pr	0.046	0.046	0.048	0.015	0.031	0.042	0.043	0.043
Rb	0.64	0.79	0.82	0.94	0.71	1.74	1.7	1.65
Re	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Sb	0.02	0.03	0.04	0.12	0.02	0.07	0.06	0.06
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sm	0.036	0.035	0.04	0.016	0.013	0.037	0.042	0.041
Sr	10.2	12.9	13.3	34	11.9	22.8	22.5	21.3
Tb	0.006	< 0.005	< 0.005	< 0.005	< 0.005	0.005	< 0.005	< 0.005
Th	0.018	0.021	0.019	0.005	< 0.005	0.019	0.02	0.018
Ti	0.9	1.3	1.3	< 0.5	< 0.5	1.4	1.3	1.3
Tl	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.009	0.007	0.009
Tm	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
U	0.012	0.018	0.022	0.008	< 0.005	0.09	0.089	0.081
V	0.17	0.19	0.23	1.18	0.43	0.6	0.65	0.66
Y	0.15	0.14	0.14	0.04	0.1	0.22	0.22	0.22
Yb	0.015	0.008	0.012	< 0.005	0.006	0.018	0.021	0.017
Zn	5.1	6.6	4.9	4	5.8	9.9	9.4	9.6

Table 10-6. Concentration (ppb or µg/L) of various elements in samples from 2000, numbers in brackets refer to locations in Figure 1.

Element	Loon (54)	Loon (55)	Major (50)	Major (50)	Major (50)	Major (51)	Major (52)	Major (53)
Ag	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Al	35	39	235	245	246	223	239	239
As	0.4	0.6	0.3	0.3	0.3	0.3	0.4	0.3
B	4.7	4.6	2.7	2.7	2.7	2.6	2.9	2.7
Ba	12.1	11.9	6.2	6.1	5.8	6	6	6.2
Be	< 0.005	< 0.005	0.126	0.126	0.129	0.118	0.119	0.114
Bi	0.03	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cd	0.045	0.044	0.186	0.144	0.263	0.197	0.133	0.092
Ce	0.12	0.12	0.33	0.33	0.34	0.32	0.33	0.34
Co	0.07	0.08	0.29	0.3	0.3	0.3	0.29	0.31
Cr	0.22	0.21	0.12	0.16	0.17	0.13	0.12	0.14
Cs	< 0.01	< 0.01	0.04	0.05	0.05	0.04	0.05	0.05
Cu	1	0.9	0.5	0.4	0.5	0.4	0.3	0.4
Dy	0.01	0.008	0.025	0.024	0.028	0.027	0.023	0.023
Er	0.005	< 0.005	0.013	0.017	0.017	0.015	0.014	0.013
Eu	< 0.005	< 0.005	0.008	0.008	0.011	0.006	0.009	0.007
Fe	72	73	54	56	56	52	54	53
Gd	0.015	0.013	0.032	0.031	0.036	0.032	0.029	0.04
Ho	< 0.005	< 0.005	0.006	< 0.005	< 0.005	< 0.005	< 0.005	0.006
In	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
La	0.09	0.09	0.23	0.24	0.24	0.23	0.25	0.24
Li	0.382	0.374	1.1	1.128	1.148	1.091	1.121	1.105
Lu	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Mn	42.6	48.4	73.4	72.5	72.5	72.6	74	73.8
Mo	0.06	0.06	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nd	0.079	0.08	0.216	0.176	0.198	0.194	0.204	0.193
Ni	0.4	0.5	0.7	0.7	0.8	0.7	0.7	0.7
Pb	0.18	0.17	0.37	0.36	0.37	0.36	0.3	0.34
Pr	0.019	0.019	0.048	0.05	0.048	0.046	0.046	0.047
Rb	1.21	1.19	0.86	0.86	0.84	0.86	0.87	0.85
Re	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Sb	0.06	0.05	0.02	0.02	0.03	0.02	0.04	0.02
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sm	0.014	0.012	0.043	0.034	0.024	0.035	0.035	0.032
Sr	32.1	31.8	7.1	7.2	7.4	7.2	7.3	7.3
Tb	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005
Th	0.023	0.006	0.01	0.01	0.006	0.009	0.012	0.005
Ti	0.5	0.6	0.9	0.9	0.8	0.7	0.9	0.8
Tl	< 0.005	< 0.005	0.008	0.008	0.008	0.008	0.007	0.008
Tm	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
U	0.006	< 0.005	0.06	0.051	0.055	0.056	0.051	0.059
V	0.36	0.35	0.86	0.88	0.89	0.82	0.87	0.85
Y	0.06	0.05	0.17	0.16	0.16	0.15	0.15	0.15
Yb	0.006	0.006	0.013	0.01	0.011	0.011	0.011	0.014
Zn	1.7	1.7	4.9	4.2	4.6	4.2	4	3.8

Table 10-7. Concentration (ppb or µg/L) of various elements in samples from 2000, numbers in brackets refer to locations in Figure 1.

Element	*Maynard (77)*	*Maynard (77)*	*Maynard (77)*	*Micmac (58)*	*Micmac (59)*	*Miller (46)*	*Morris (62)*	*Morris (62)*
Ag	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Al	26	27	26	30	30	168	34	33
As	0.4	0.3	0.4	2	1.9	0.1	0.3	0.4
B	6.1	5.7	5.7	7.7	8.1	2.7	5.1	5
Ba	16.8	16.9	17.7	12.9	13.2	6.9	15.2	15.1
Be	< 0.005	< 0.005	< 0.005	0.005	< 0.005	0.03	0.01	0.007
Bi	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.03	< 0.01
Cd	0.064	0.021	0.02	0.063	0.076	0.12	0.255	0.033
Ce	0.1	0.1	0.1	0.15	0.15	0.44	0.1	0.1
Co	0.09	0.09	0.08	< 0.05	< 0.05	0.49	< 0.05	< 0.05
Cr	0.25	0.27	0.28	0.29	0.3	0.21	0.24	0.27
Cs	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.02	< 0.01	< 0.01
Cu	1.5	1.3	1.2	1.6	1.5	0.9	1.4	1.1
Dy	0.007	0.008	0.011	0.021	0.02	0.032	0.012	0.01
Er	< 0.005	< 0.005	< 0.005	0.007	0.008	0.013	0.006	< 0.005
Eu	< 0.005	< 0.005	< 0.005	0.005	0.006	0.01	< 0.005	< 0.005
Fe	82	82	83	31	32	141	39	36
Gd	0.016	0.008	0.011	0.025	0.022	0.042	0.013	0.01
Ho	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.006	< 0.005	< 0.005
In	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
La	0.08	0.08	0.08	0.16	0.16	0.23	0.09	0.09
Li	0.231	0.233	0.241	0.38	0.404	1.111	0.466	0.477
Lu	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Mn	70.1	71.5	74.3	30.8	33.4	110.2	29.7	28.7
Mo	0.08	0.08	0.08	0.09	0.12	< 0.05	0.07	0.05
Nd	0.064	0.072	0.053	0.138	0.143	0.233	0.091	0.08
Ni	1	0.9	0.9	0.6	0.7	1.8	0.7	0.7
Pb	0.3	0.28	0.28	0.15	0.14	0.29	0.14	0.09
Pr	0.015	0.016	0.017	0.031	0.032	0.055	0.019	0.021
Rb	1.3	1.27	1.33	1.2	1.24	0.77	1.05	1.04
Re	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Sb	0.08	0.07	0.09	0.13	0.14	0.02	0.08	0.06
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sm	0.019	0.011	0.015	0.02	0.036	0.059	0.018	0.016
Sr	42	41.9	42.4	48.1	49.3	11.8	32.9	32.7
Tb	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.006	< 0.005	< 0.005
Th	< 0.005	< 0.005	0.01	< 0.005	< 0.005	0.01	0.016	0.007
Ti	0.6	0.6	0.8	< 0.5	0.5	0.8	0.8	0.9
Tl	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005	< 0.005	< 0.005
Tm	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
U	0.005	0.007	0.008	0.039	0.033	0.042	0.009	0.01
V	0.79	0.85	0.77	0.69	0.7	0.28	0.45	0.47
Y	0.05	0.05	0.05	0.1	0.1	0.16	0.06	0.06
Yb	< 0.005	< 0.005	< 0.005	0.007	< 0.005	0.018	0.005	0.006
Zn	4.3	3.9	3.7	3.4	3	5.5	3.1	2.1

Table 10-8. Concentration (ppb or µg/L) of various elements in samples from 2000, numbers in brackets refer to locations in Figure 1.

Element	Morris (63)	Morris (64)	Morris (64)	Oathill (75)	Oathill (75)	Paper Mill (16)	Parr (33)	Penhorn (76)
Ag	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Al	41	38	38	52	27	169	281	28
As	0.3	0.2	0.4	0.2	0.4	0.2	0.3	0.3
B	5	4.5	4.5	4	7.1	3.8	2.9	4.5
Ba	16	15.9	16.1	14.3	28.5	16.7	3.3	22.7
Be	0.012	0.015	0.009	0.021	< 0.005	0.051	0.064	< 0.005
Bi	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cd	0.497	0.525	0.06	0.033	0.032	0.2	0.385	0.029
Ce	0.12	0.12	0.1	0.13	0.09	0.22	0.26	0.07
Co	0.06	0.07	0.07	0.14	0.06	0.13	0.18	0.06
Cr	0.28	0.27	0.25	0.12	0.53	0.18	0.14	0.4
Cs	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05	0.06	< 0.01
Cu	1.5	1.7	1.6	0.6	2.1	0.9	0.7	1.4
Dy	0.011	0.014	0.011	0.012	0.009	0.024	0.022	< 0.005
Er	0.005	0.006	0.007	0.007	0.01	0.014	0.013	0.006
Eu	0.006	0.006	< 0.005	0.006	< 0.005	0.007	< 0.005	< 0.005
Fe	42	41	43	10	59	93	202	31
Gd	0.027	0.026	0.015	0.021	0.013	0.026	0.028	0.01
Ho	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
In	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
La	0.11	0.11	0.1	0.1	0.11	0.16	0.11	0.05
Li	0.519	0.5	0.51	0.314	0.579	1.237	1.032	0.348
Lu	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Mn	41.7	49.2	71.6	33.3	55.9	31.7	39.5	57
Mo	0.05	0.06	0.06	< 0.05	0.15	0.08	< 0.05	0.11
Nd	0.095	0.109	0.1	0.074	0.088	0.125	0.124	0.039
Ni	0.8	0.9	0.7	1	0.7	0.7	0.5	0.5
Pb	0.23	0.18	0.16	0.09	0.2	0.44	0.62	0.15
Pr	0.021	0.022	0.023	0.023	0.02	0.033	0.029	0.011
Rb	1.1	1.08	1.06	0.74	1.56	1.44	0.82	0.97
Re	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Sb	0.08	0.08	0.07	0.03	0.11	0.05	0.03	0.06
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sm	0.014	0.017	0.024	0.017	0.021	0.02	0.025	0.006
Sr	33.4	33.4	34.1	11.3	62.9	22.9	4.3	51.4
Tb	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Th	0.009	0.008	0.01	< 0.005	0.008	0.013	0.009	0.006
Ti	0.9	0.7	1	< 0.5	1	1.2	1.3	0.6
Tl	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.006	0.008	< 0.005
Tm	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
U	0.01	0.012	0.011	< 0.005	0.014	0.062	0.034	0.015
V	0.46	0.42	0.49	0.29	1.24	0.5	0.54	0.73
Y	0.07	0.06	0.06	0.05	0.08	0.15	0.13	0.04
Yb	0.009	< 0.005	< 0.005	< 0.005	0.01	0.013	0.009	< 0.005
Zn	4.9	5.7	3	2.3	7.8	5.4	4.2	5.2

Table 10-9. Concentration (ppb or µg/L) of various elements in samples from 2000, numbers in brackets refer to locations in Figure 1.

Element	Powder Mill (11)	Power Pond (86)	Rocky (12)	Rocky (12)	Rocky (13)	Russell (65)	Russell (66)	S. Chain (26)
Ag	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Al	26	283	26	149	30	41	42	923
As	1.2	0.4	0.5	0.3	0.4	0.3	0.3	0.2
B	5.2	3.8	5.2	2.7	4.8	5.1	4.9	2.9
Ba	16.3	8.8	18	7.6	21.1	28.8	28.7	22.5
Be	< 0.005	0.101	0.016	0.031	< 0.005	0.007	0.012	0.219
Bi	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.01	0.01	< 0.01
Cd	0.063	0.054	0.09	0.18	0.06	0.035	0.046	0.237
Ce	0.08	0.29	0.1	0.38	0.08	0.08	0.09	0.57
Co	< 0.05	0.35	< 0.05	0.36	0.07	0.07	0.08	3.11
Cr	0.25	0.19	0.29	0.2	0.26	0.24	0.26	0.11
Cs	< 0.01	0.04	< 0.01	0.01	< 0.01	< 0.01	< 0.01	0.11
Cu	0.7	0.9	1.4	1	0.8	1	1	0.9
Dy	0.008	0.034	0.015	0.027	0.013	0.01	0.011	0.071
Er	< 0.005	0.022	0.006	0.01	0.005	0.005	< 0.005	0.035
Eu	< 0.005	0.006	0.005	0.012	< 0.005	< 0.005	< 0.005	0.012
Fe	46	169	44	129	43	51	51	65
Gd	0.01	0.033	0.019	0.045	0.014	0.012	0.014	0.063
Ho	< 0.005	0.006	< 0.005	0.006	< 0.005	< 0.005	< 0.005	0.015
In	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
La	0.08	0.17	0.11	0.22	0.08	0.09	0.1	0.49
Li	0.482	1.891	0.614	1.025	0.568	0.515	0.542	5.838
Lu	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Mn	21.8	49.3	6.9	97.5	22.9	141.5	137.7	127.1
Mo	0.07	< 0.05	0.12	< 0.05	0.11	0.07	0.07	< 0.05
Nd	0.07	0.153	0.103	0.2	0.062	0.074	0.07	0.272
Ni	0.2	1.3	0.2	1.6	0.2	0.9	0.9	6.5
Pb	0.13	0.55	0.13	0.35	0.13	0.1	0.12	0.75
Pr	0.017	0.041	0.022	0.053	0.017	0.018	0.019	0.069
Rb	1.75	1.61	2.4	0.82	1.95	1.08	1.09	2.19
Re	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Sb	0.09	0.04	0.09	0.04	0.1	0.07	0.06	0.02
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sm	0.02	0.034	0.024	0.047	0.019	0.015	0.021	0.054
Sr	35.6	19.1	45.6	12.3	46.3	45.2	44.7	31.4
Tb	< 0.005	0.006	< 0.005	0.006	< 0.005	< 0.005	< 0.005	0.011
Th	< 0.005	0.019	0.006	0.011	0.008	0.012	0.007	< 0.005
Ti	0.5	1.3	0.6	0.8	0.5	0.6	< 0.5	0.6
Tl	< 0.005	0.009	< 0.005	0.006	< 0.005	< 0.005	< 0.005	0.015
Tm	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
U	0.024	0.112	0.062	0.04	0.051	0.007	0.009	0.026
V	0.2	0.98	0.21	0.25	0.23	0.48	0.48	< 0.10
Y	0.06	0.2	0.08	0.14	0.06	0.06	0.06	0.49
Yb	0.006	0.015	0.009	0.01	< 0.005	0.006	0.012	0.032
Zn	2.2	9.1	2.1	5.6	2.1	2.9	2.8	20.4

Table 10-10. Concentration (ppb or µg/L) of various elements in samples from 2000, numbers in brackets refer to locations in Figure 1.

Element	Sandy (14)	Sandy (15)	Second (10)	Second (9)	Settle (81)	Soldier (43)	Soldier (44)	Soldier (45)
Ag	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Al	180	167	61	46	46	197	209	206
As	0.3	0.3	0.2	0.3	0.4	0.2	0.2	0.2
B	4.2	3.9	4	3.6	5.2	2.7	2.6	2.6
Ba	16.4	16.9	16.1	14.3	19.6	6.4	6	6
Be	0.027	0.023	0.01	0.006	0.008	0.039	0.043	0.042
Bi	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cd	0.16	0.123	0.146	0.148	0.094	0.449	0.123	0.14
Ce	0.49	0.45	0.15	0.1	0.26	0.48	0.51	0.54
Co	0.93	0.85	0.07	0.05	0.11	0.61	0.64	0.69
Cr	0.21	0.19	0.25	0.15	0.44	0.23	0.23	0.26
Cs	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.02	0.02	0.02
Cu	1.1	2.3	0.7	0.7	1.7	1.3	0.9	1
Dy	0.036	0.036	0.017	0.014	0.015	0.03	0.034	0.036
Er	0.021	0.024	0.007	0.007	0.013	0.02	0.017	0.018
Eu	0.012	0.014	0.005	< 0.005	0.007	0.011	0.013	0.011
Fe	113	113	62	41	164	167	171	165
Gd	0.054	0.048	0.023	0.018	0.016	0.043	0.043	0.04
Ho	0.007	0.007	< 0.005	< 0.005	< 0.005	0.008	0.007	0.008
In	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
La	0.26	0.27	0.09	0.06	0.15	0.26	0.27	0.26
Li	1.139	1.111	0.412	0.345	0.34	1.203	1.225	1.231
Lu	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Mn	123.4	117.1	28.4	17	92.9	128.7	140.9	138.6
Mo	< 0.05	< 0.05	< 0.05	< 0.05	0.09	< 0.05	< 0.05	< 0.05
Nd	0.237	0.245	0.111	0.074	0.128	0.257	0.257	0.254
Ni	2.2	2.1	0.4	0.3	0.4	2.1	2	1.9
Pb	0.25	0.3	0.13	0.13	0.28	0.31	0.4	0.35
Pr	0.061	0.063	0.026	0.018	0.029	0.061	0.059	0.063
Rb	1.09	1.13	1.02	0.89	1.3	0.83	0.89	0.85
Re	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Sb	0.04	0.03	0.03	0.03	0.08	0.03	0.02	0.01
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sm	0.038	0.057	0.028	0.014	0.023	0.042	0.055	0.058
Sr	17.6	19.4	20.7	17.8	43.7	11.7	11.2	11.7
Tb	0.007	0.006	< 0.005	< 0.005	< 0.005	0.006	0.006	0.008
Th	0.012	0.011	0.015	0.01	0.013	0.007	0.014	0.014
Ti	1.1	1	1.1	0.6	1.5	0.8	0.9	0.9
Tl	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.008	< 0.005
Tm	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
U	0.012	0.014	0.009	0.007	0.017	0.044	0.053	0.043
V	0.27	0.23	0.15	0.15	0.73	0.36	0.29	0.34
Y	0.2	0.19	0.08	0.06	0.08	0.18	0.18	0.18
Yb	0.015	0.012	0.007	< 0.005	0.007	0.011	0.016	0.016
Zn	8.3	10.6	2.4	1.8	3.9	7	5.6	5.7

Table 10-11. Concentration (ppb or µg/L) of various elements in samples from 2000, numbers in brackets refer to locations in Figure 1.

Element	Spider (48)	Spider (49)	Spruce Hill (34)	Susie (19)	Susie (19)	Susie (20)	Third (7)	Third (8)
Ag	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Al	185	216	279	255	268	258	32	34
As	< 0.1	0.2	0.3	0.2	0.2	0.3	0.3	0.3
B	2.4	2.6	2.8	2.7	2.7	2.5	4.8	4.8
Ba	8	6.6	3.6	8.9	8.9	8.4	15.8	16.4
Be	0.038	0.038	0.059	0.105	0.109	0.132	0.007	< 0.005
Bi	< 0.01	< 0.01	0.03	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cd	0.404	0.131	0.394	0.163	0.423	0.218	0.129	0.123
Ce	0.47	0.64	0.25	0.21	0.21	0.19	0.11	0.11
Co	0.16	0.46	0.18	0.25	0.26	0.21	< 0.05	< 0.05
Cr	0.13	0.2	0.21	0.18	0.17	0.21	0.17	0.21
Cs	< 0.01	< 0.01	0.06	0.04	0.04	0.04	< 0.01	< 0.01
Cu	0.9	0.6	0.9	0.4	0.9	0.4	0.8	0.8
Dy	0.028	0.038	0.026	0.026	0.024	0.029	0.011	0.01
Er	0.017	0.018	0.014	0.011	0.017	0.018	< 0.005	0.007
Eu	0.012	0.014	< 0.005	0.007	0.005	< 0.005	< 0.005	0.005
Fe	43	164	203	114	112	129	36	38
Gd	0.043	0.046	0.025	0.028	0.027	0.021	0.012	0.011
Ho	0.006	0.007	0.005	< 0.005	< 0.005	0.006	< 0.005	< 0.005
In	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
La	0.47	0.39	0.11	0.12	0.13	0.12	0.08	0.07
Li	0.42	0.493	1.018	1.303	1.34	1.282	0.427	0.429
Lu	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Mn	85.7	89.2	38.6	43	44.2	39.6	23.5	24.6
Mo	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nd	0.268	0.318	0.12	0.117	0.111	0.118	0.076	0.081
Ni	1.3	1.1	0.5	0.9	0.9	0.8	0.4	0.4
Pb	0.36	0.42	0.63	0.47	0.92	0.45	0.16	0.14
Pr	0.078	0.077	0.033	0.03	0.034	0.031	0.017	0.019
Rb	0.49	0.56	0.82	1.11	1.14	1.15	1.06	1.04
Re	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Sb	0.02	0.02	0.03	0.04	0.04	0.02	0.11	0.09
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sm	0.058	0.052	0.024	0.025	0.028	0.023	0.025	0.012
Sr	8.1	7.5	4.5	14.7	14.8	14.5	22.1	22.4
Tb	< 0.005	0.007	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Th	0.007	0.013	0.016	0.012	0.01	0.011	0.008	0.008
Ti	0.6	1.1	1.3	0.9	1	1.1	< 0.5	0.5
Tl	< 0.005	< 0.005	0.008	0.01	0.011	0.006	< 0.005	< 0.005
Tm	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
U	< 0.005	< 0.005	0.033	0.059	0.064	0.067	0.013	0.011
V	0.45	0.91	0.57	0.78	0.76	0.83	0.16	0.14
Y	0.2	0.21	0.13	0.16	0.16	0.18	0.06	0.06
Yb	0.014	0.018	0.011	0.01	0.013	0.013	0.006	0.007
Zn	6.5	5.1	4.1	8.7	9.3	7.6	3.4	3.2

Table 10-12. Concentration (ppb or µg/L) of various elements in samples from 2000, numbers in brackets refer to locations in Figure 1. Last column is the detection limit for each element.

Element	Thomas (38)	Thomas (39)	Topsail (74)	Whimsical (84)	William (40)	William (41)	William (42)	Williams (31)	Detection Limit
Ag	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.010
Al	79	46	86	61	50	50	57	153	2
As	1.3	2	0.2	0.2	1.5	1.5	1.7	0.3	0.1
B	3.9	4.6	3.1	7.5	4.6	4.8	4.9	4.5	0.5
Ba	10.4	11.8	11.2	18.7	11.9	11.7	11.5	12	0.2
Be	0.015	0.011	0.049	0.015	0.007	0.005	0.008	0.075	0.005
Bi	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.01
Cd	0.119	0.129	0.066	0.035	0.134	0.159	0.149	0.12	0.01
Ce	0.26	0.17	0.15	0.07	0.19	0.19	0.21	0.14	0.01
Co	0.17	0.08	0.35	0.12	0.08	0.09	0.12	0.25	0.05
Cr	0.25	0.22	< 0.10	0.26	0.3	0.19	0.22	0.17	0.1
Cs	< 0.01	< 0.01	0.02	0.07	< 0.01	< 0.01	< 0.01	0.06	0.01
Cu	1	1	0.5	1.3	0.9	0.8	0.8	1	0.1
Dy	0.026	0.019	0.01	0.018	0.02	0.02	0.022	0.021	0.005
Er	0.012	0.014	0.008	0.015	0.009	0.013	0.008	0.013	0.005
Eu	0.007	0.006	< 0.005	< 0.005	0.007	< 0.005	0.007	< 0.005	0.005
Fe	80	45	27	42	42	41	51	50	5
Gd	0.033	0.022	0.011	0.008	0.027	0.023	0.03	0.022	0.005
Ho	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005
In	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005
La	0.18	0.19	0.15	0.09	0.2	0.2	0.23	0.11	0.01
Li	0.68	0.461	0.934	1.923	0.473	0.467	0.468	1.725	0.005
Lu	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005
Mn	57.3	33.3	65.5	11.9	33.8	33.2	34.3	22.2	0.1
Mo	< 0.05	0.06	< 0.05	0.26	< 0.05	< 0.05	< 0.05	< 0.05	0.05
Nd	0.157	0.159	0.107	0.05	0.163	0.176	0.172	0.092	0.005
Ni	1	0.4	1.3	1.5	0.4	0.5	0.5	1.6	0.2
Pb	0.2	0.15	0.11	0.17	0.15	0.14	0.16	0.35	0.01
Pr	0.04	0.037	0.03	0.014	0.041	0.039	0.047	0.025	0.005
Rb	1.12	1.29	0.82	2.66	1.31	1.29	1.29	1.73	0.05
Re	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005
Sb	0.04	0.06	0.01	0.1	0.06	0.06	0.08	0.08	0.01
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1
Sm	0.038	0.027	0.013	0.012	0.026	0.025	0.028	0.026	0.005
Sr	22.8	27.6	11.6	74.5	27.8	27.4	27.4	23.7	0.5
Tb	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005
Th	0.008	0.006	< 0.005	0.006	0.007	0.008	0.008	0.007	0.005
Ti	1	< 0.5	< 0.5	< 0.5	0.6	0.7	0.8	0.6	0.5
Tl	< 0.005	< 0.005	< 0.005	0.007	< 0.005	< 0.005	< 0.005	< 0.005	0.005
Tm	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005
U	0.025	0.015	0.006	0.147	0.015	0.015	0.015	0.084	0.005
V	0.26	0.3	0.3	0.42	0.34	0.38	0.33	0.87	0.1
Y	0.13	0.13	0.08	0.13	0.13	0.13	0.14	0.13	0.01
Yb	0.01	0.008	0.007	0.021	0.008	0.008	0.013	0.01	0.005
Zn	5.1	3.5	4.7	4.1	2.4	3	3.4	11.3	0.5